TEMS™ CellPlanner

Common Features Technical Reference Manual

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Preface

Document Conventions

This document uses the following conventions:

Bold type	Window names, button names, and keyboard keys are displayed as bold text. Example: Click **Edit.**
Menu↗Selection	Navigation in menu paths are displayed as bold text with arrows between menu levels.
`Typewriter type`	File names and literal input and output. Example: `sites.xml`
Italic type	Book titles and definitions are displayed in italic. Examples: *carrier mapping, Technical Reference Manual*
Left-click Right-click	All instructions including mouse clicks assume a mouse configured with the left mouse button as primary button.

Navigation

Use the ALT ← and ALT → buttons to navigate between link jumps in the Manuals.

Assumed Knowledge

This documentation presumes that you have good knowledge about radio network planning principles and the radio technology to plan.

Disclaimer

The parameter values in this manual are just examples to help you getting started quickly, and do not constitute any performance guarantees for the planned equipment of your final network planning.

Proper parameter values depend on the equipment version, the operator's business plan, and the operator's network deployment strategy. Recommended parameter values should be provided by the operator, the equipment vendor or your service delivery organization.

Manuals

The following PDF manuals are delivered with the TEMS CellPlanner software:

Installation Guide

EN/LZT 108 9831 R4A

Describes system requirements, how to install and configure TEMS CellPlanner components and manage licenses, and provides an overview of all TEMS CellPlanner components. The procedures must be performed by a user with administrator privileges on the local computer. Some procedures require that you are an authorized TEMS CellPlanner administrator.

Common Features User's Guide

EN/LZT 108 9832 R4A

Includes Glossary of terms used in TEMS CellPlanner, concepts about licenses, and how use projects, explorer objects used by more than one radio technology, how to add sites and use site tools, filters, plots, neighbors, AMI, tuning propagation models, ASMT (Automatic Sector Model Tuning), puncturing, export and import data, and work with projects on server. Here TEMS CellPlanner administrators find how to administer users, groups and projects on servers shared by multiple users.

Common Features Technical Reference Manual

EN/LZT 108 9833 R4A

Describes radio technology independent algorithms, parameters and file formats.

GeoData User's Guide

EN/LZT 108 9834 R4A

Describes geodata concepts, supported geodata formats, conversion between different map formats, how to use map data tools in TEMS CellPlanner. The chapters about providing and importing map data are intended for administrators of map data. Other chapters are intended for users of map data.

Map Import Wizard User's Guide

EN/LZT 108 9943 R2A

Describes how to import map data using a generic wizard similar to the one provided with TEMS LinkPlanner. The intended reader is administrator of map data.

LTE User's Guide

EN/LZT 108 9944 R3A

Describes how to use LTE functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

LTE Technical Reference Manual

EN/LZT 138 0235 R2A

Describes LTE network planning principles, analysis details for advanced users, and cell ID planning principles.

WCDMA User's Guide

EN/LZT 108 9837 R4A

How to use WCDMA functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

WCDMA Technical Reference Manual

EN/LZT 108 9838 R4A

Describes concepts and overviews of WCDMA algorithms, and HSPA and MBMS in TEMS CellPlanner.

GSM User's Guide

EN/LZT 108 9835 R4A

Describes how to use the GSM functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

GSM Technical Reference Manual

EN/LZT 108 9836 R4A

Describes overlaid/underlaid cell structures, reuse patterns, manual frequency planning, automatic frequency planning (AFP), automatic hopping frequency set (HFS) planning, optimization of BSIC, HSN and MAIO, fractional load planning, and effective subscriber modeling. Also describes the GSM algorithms and file formats used in TEMS CellPlanner.

WiMAX User's Guide

EN/LZT 108 9839 R4A

Describes how to use the WiMAX functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

1
Overview of TEMS CellPlanner

This chapter provides an overview of the TEMS CellPlanner product.

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About TEMS CellPlanner

TEMS™ CellPlanner is a graphical PC-based application for designing, implementing, and optimizing mobile radio networks. It assists you in performing complex tasks, including network dimensioning, traffic planning, site configuration, frequency planning, and network optimization.

Installation

The Installation Guide describes how to install software and licenses.

Product Packaging

The product package includes the software components listed below.

What is actually installed depends on your selection in the installation wizard.

Product Components	Selecting this component installs...
• TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	• Radio Technology Features • Planning Features • Manuals • Map tools, geodata conversion software, demo maps, filters, scripts • Citrix software - relevant only if you are going to offer this TEMS CellPlanner installation as a Citrix service
• Enterprise Server	Enterprise Server software plus the User Administration software
• Zero Admin Server	Zero Admin Server software plus the User Administration software
• User Administration	User Administration software only
• License Server	License Server software only

Some of the components are licensed, see Licensed Components on page 1-3.

The Installation Guide provides an overview of each component and how the components relate to each other.

Licenses

The Installation Guide describes how to install licenses.
The Common Features User's Guide describes how to activate licensed features.

Licensed Components

Three of the Product Components are licensed:

TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	To start TEMS CellPlanner you need a license for at least one of the Radio Technology Features. Additional licenses are required for each of the Radio Technology Features and Planning Features to use.
Enterprise Server	License required to start the server
Zero Admin Server	License required to start the server

Radio Technology Features

Each of the radio technology software modules listed below require an installed and activated license. How to use the radio technology software is described in adherent user guides and technical reference manuals.

- GSM
- WCDMA
- WCDMA,HSPA
- WiMAX
- LTE

Planning Features

Additional planning features can be used together with the radio technology software. These additional software modules require a license for the feature itself and a license for the adherent radio technology:

• Automatic Cell Planning	Requires WCDMA or WCDMA,HSPA license
• Automatic Frequency Planning	Requires GSM license. This license is required also for automatic HFS planning.
• Automatic Measurement Integration and ASMT	Requires license for at least one of the Radio Technology Features ASMT = Automatic Sector Model Tuning.

Support and FAQ

For support and FAQ about TEMS CellPlanner, use the TEMS support web site:

www.ascom.com/networktesting

To provide TEMS support with information when reporting a problem, follow the instructions in chapter *Support Information* in the Installation Guide.

2
Propagation Models

This chapter describes the propagation models used in TEMS CellPlanner.

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2.1 Propagation Model Concepts

The following propagation models are supported by TEMS CellPlanner:

- Ericsson 9999 model
- Ericsson Urban model
- Okumura-Hata model
- Walfish-Ikegami model

The models are used for analysis of macro, mini, micro, and pico cells.

2.1.1 Cell Types in Propagation Models

Cell types described by propagation models include:

Cell Type	Definition
Macro Cell	In a macro cell, the base station antenna is placed above the rooftops. It usually has a cell radius of more than 1 km. Applications are for rural areas as well as for urban environments.
Mini Cell	A mini cell is a small macro cell. The base station antenna is placed at the same height as the rooftops. These cells are used only in urban environments. The cell radius is about 700 - 1000 m.
Micro Cell	In a micro cell, the base station antenna is placed at street level. A typical antenna height is 5 m. It typically has a cell radius of 200 - 500 m. It is used for increasing the coverage and the capacity in a dense urban environment.
Pico Cell	A pico cell is an indoor cell. The cell radius is about 10 - 20 m since it is limited by the building itself because of high penetration losses in the walls.

2.1.2 Terminology

The following terms are used in the discussion of propagation models:

Acronym	Meaning
a	Parameter controlling the addition of the diffraction losses *KDFR* and *JDFR*
COST	European Co-Operation in the field of Scientific and Technical research
Cs	Height from a straight line (transmitter-receiver) to the peak of the knife-edge
d[q]	Vector containing the distances to the topography points
EIRP	Effective Isotropic Radiated Power
GPS	Global Positioning System

Acronym	Meaning
h[q]	Vector containing ground elevations in the topography points
HB	Antenna height of the transmitter (radio base station)
HEB	Effective antenna height
HEBK	Empirically corrected effective antenna height
HM	Antenna height of the receiver (mobile)
JDFR	Spherical earth diffraction
JHEB	Effective height of the radio base station antenna, calculated for the spherical earth algorithm
JHEM	Effective height of the mobile antenna, calculated for the spherical earth algorithm
KDFR	Knife-edge diffraction
l	Wave length
LoS	Line of Sight
maxtopp	Local peak identified as the most disturbing knife-edge
mk[q]	Vector containing the land use codes in the topography points
mobil	Point on the terrain profile where pathloss is calculated
NLoS	Non Line of Sight
OA	Open Area
PL	Calculated pathloss
RF	Radio Frequency
RMS	Root Mean Square
RNDT	Radio Network Design Tool
RNPT	Radio Network Proposal Tool
RX	Receiver
temp	Value directly proportional to *U*
TEMS	Test Mobile System
TMR	Test Measurement Receiver
topography points	Make up the terrain profile
TTM	Test TransMitter
TX	Transmitter
U	Diffraction parameters pertaining to knife-edge

2.2 9999 Propagation Model

The 9999 propagation model calculates the expected pathloss for radio waves between the transmitter antenna and the receiver antenna using the terrain profile.

The model is based on the Okumura-Hata model, enhanced by a large number of wave propagation measurements.

Valid Ranges

The 9999 model is valid for the following ranges:

- 150 - 2000 MHz
- 0.2 - 100 km
- 20 - 200 m
- 1 - 5 m

Although the validity is stated as 2 GHz, the model can be adapted to higher frequency bands by tuning against measurements.

Required Map Data

Required map data includes:

- Elevation
- Land use

The land use code is the index that specifies how the ground is used.

The pathloss also depends on the frequency and the antenna heights of the transmitter and receiver.

How the Model Works

The 9999 propagation model considers the terrain profile: the cross-section of the earth along the straight line between transmitter and receiver.

Pathloss depends on frequency and antenna heights of the transmitter and receiver. The 9999 model allows for both uptilt and downtilt of antennas, taking into account the vertical antenna pattern.

Model Input Sources

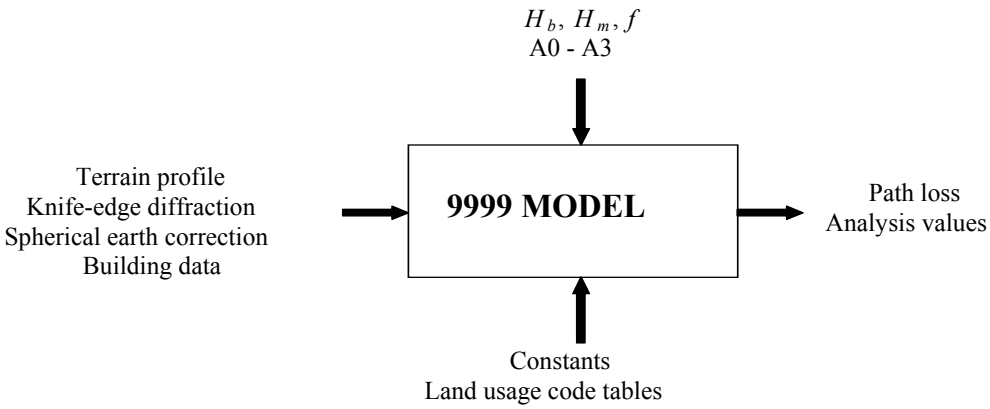
The pathloss value obtained from the 9999 model consists of the following three input sources, summarized as follows:

- Okumura-Hata's wave propagation equations with modifying parameters A0 - A3.

- Extra loss, occurring when wave propagation is disturbed by obstacles such as mountain peaks. When the distance between the transmitter and receiver becomes sufficiently large, a correction due to earth's curvature is necessary.
- Land use code loss.

9999 Propagation Model Process

Output from the model is the pathloss Λ_b [dB], described in the formula below:



9999 Model Pathloss

The pathloss formula of the 9999 propagation model is:

$$L_b = HOA + mk[mobile] + \sqrt{(\alpha \cdot KDFR)^2 + (JDFR)^2}$$

where

L_b = pathloss

Hata Open Area

HOA = A0 + A11 + A2 log HEBK + A3 log d log HEBK - 3.2[log(11.75 hm)]^2 + g(F)

where

A11 = A1 * log d

g(F) = 44.49 * log F - 4.78 * (log F)^2

and

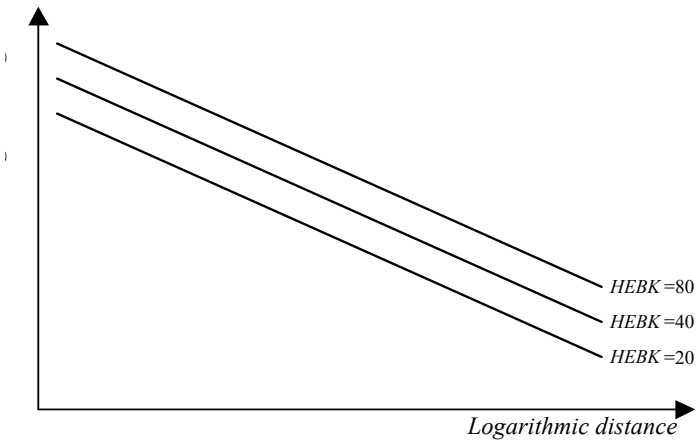
Variable	Meaning
HEBK	Effective antenna height in m as defined in the 9999 propagation model
d	Distance from base antenna to mobile in km
A0, A1, A2 and A3	Model tuning parameters

2.2.1 Parameter Settings and Land Use Values

The propagation slope is affected by changing some parameters while keeping the others at the default values.

Effective Antenna Height

The effective antenna height, *HEBK*, affects the signal strength. The following figure shows the relationship between the signal strength and the distance from the transmitter antenna for different values of HEBK.



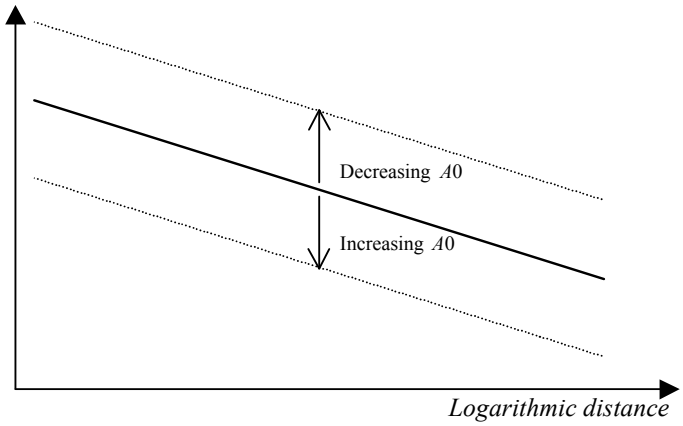
Parameters *A*0 - *A*3

Default settings for *A*0 - *A*3 are shown the following table. These settings are valid for all frequencies.

Parameter	Default	Function
*A*0	36.2	Regulates the absolute level of the line and moves the line in parallel up or down.
*A*1	30.7	Changes the slope of the line.
*A*2	-12.0	Regulates vertical distance between two propagation lines with different effective antenna heights.
*A*3	0.1	Changes the slope of the line.

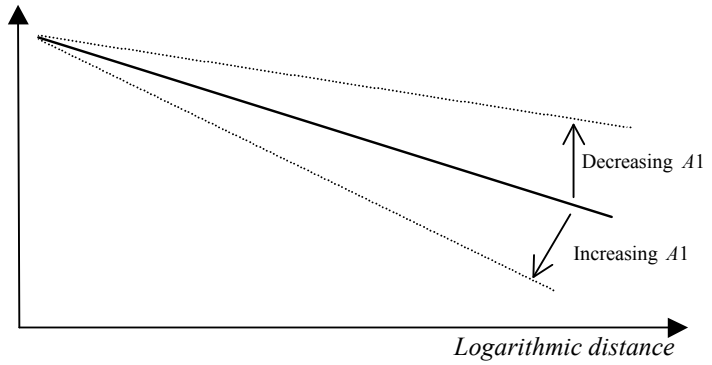
Effects on Propagation Slope by Changing Parameter *A*0

The following illustration shows the effects on the propagation slope from changing A0 while all other parameters constant. Parameters *A*1- *A*3 are set to the default values and *HEBK* is assumed to be constant.



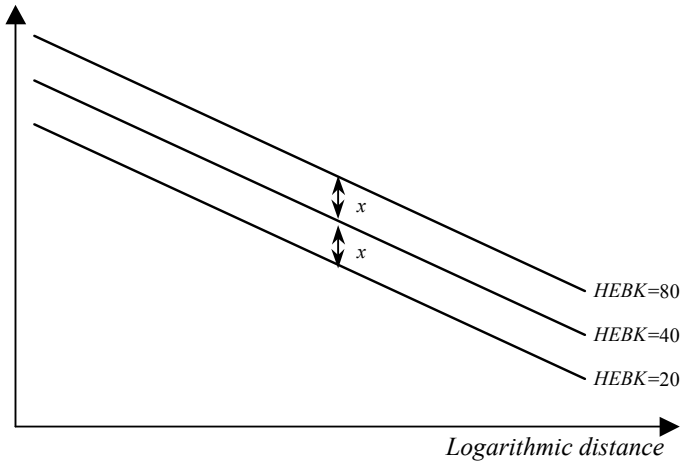
Effects on Propagation Slope by Changing Parameter A1

If *A*1 increases, the propagation slope increases. If *A*1 decreases, the slope decreases, as shown in the following illustration.



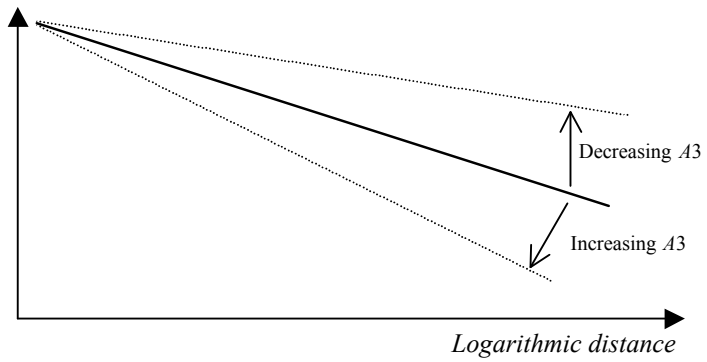
Changing Parameter A2 Vertical Distance Between Two Lines

As shown in the following illustration, if *A*2 increases, the vertical distance (= *x*) decreases, and if *A*2 decreases, the vertical distance increases.



Effects on Propagation Slope by Changing Parameter A3

As shown in the following illustration, if *A*3 increases, the propagation slope increases. If *A*3 decreases, the slope decreases. The increase or decrease of the slope depends on *HEBK*. The larger value of *HEBK,* the greater the effect.



where

Variable	Meaning
HOA	HOA (Hata Open Area) [dB] is a variant of Okumura-Hata's equation
mk[mobile]	The land use code at mobile [dB]
α	A parameter connected to knife-edge diffraction
KDFR	The contribution from knife-edge diffraction [dB]
JDFR	The diffraction loss due to spherical earth [dB]

Land Use Code Values for 2050 MHz

Land use code values for 2050 MHz are based on measurements in a typical European radio environment. The land use values for 2050 MHz have been extracted from land use values for 900 MHz and 1800 MHz.

The following table gives some examples of land use values for the WCDMA band:

Land Use Code Type	***mk[mobile]*** **[dB]**
Suburban	20.6 - 24.2
Urban	25.6 - 29.2
Marsh	14.0
Open Land	4.4
Pine Forest	21.9
Half-open	17.6
Forest	17.9
Water	3.4
Village	15.7

These figures are rough estimates based on findings from earlier measurements showing that the difference between land use code values are the same between 450 MHz and 900 MHz as between 900 MHz and 1800 MHz.

Although the estimated values for 2050 MHz are based on measurements, they are analytically extracted. Considering a specific propagation case, the values may be further improved by tuning with measurements for the UMTS band.

2.3 Urban Propagation Model

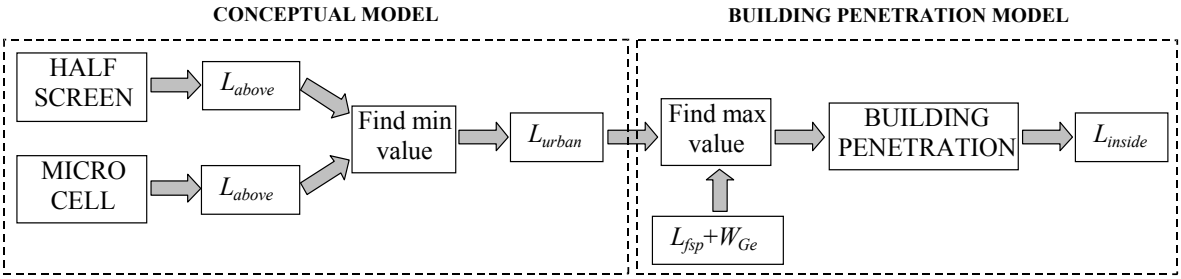
In an urban environment, the two dominant paths for radio wave propagation are over rooftops and along streets. At a far distance from the site, the first part dominates, but in a near environment of the site, the second part dominates.

The Urban model is composed of three different wave propagation algorithms:

- Half-Screen model
- Recursive Micro Cell model
- Building Penetration model

Urban Model Concept

In the concept of the Urban model, the resulting output value for the pathloss is the minimum of the pathloss values calculated by the Half-Screen model and the Recursive Micro Cell model, shown in the following illustration.



Valid Ranges

The Urban model is valid under the following conditions:

- For frequencies from 450 MHz up to 2200 MHz
- For points at a close distance from the base antenna and for distances up to at least 50 km from the base antenna
- For base antenna heights from 5 m to 60 m with antennas placed above rooftops or below rooftops but outside the building
- For high mobile antenna heights, used for wireless local loop applications

2.3.1 Half-Screen Model Propagation Algorithm

The Half-Screen model is used for calculating the propagation above the rooftops. Obstacles such as buildings and trees between the transmitter and the mobile are modeled with a number of screens with heights correlated to the heights of the obstacles. The pathloss is then calculated by using a multiple knife-edge approach.

Half-Screen Model Pathloss

The pathloss Λ_{above} [dB] is given in the following formula:

$$L_{above} = 20\log\left(\frac{4\pi d}{\lambda u}\right)$$

where

Variable	Meaning
d	Distance between transmitter and receiver [m]
l	Wavelength [m]
u	Normalized electric field along the path [dimensionless]

The electric field, *u*, is determined by using a multiple knife-edge approach. Obstacles along the path from the transmitter to the receiver are modeled by using half-endless screens with different heights and separations.

Forward-Difference Method for Electric Field Determination

The values of υ are set to 1 above and on the screen and 0 below the screen, on a straight line that passes through the first screen. The following *u* values along the profile are then determined numerically by using the forward-difference method shown in the following formula:

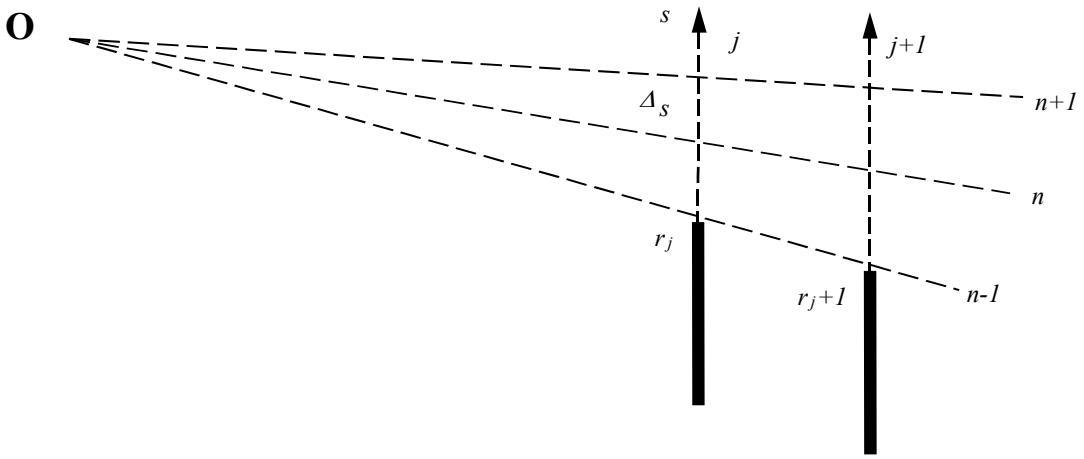
$$un,j+1 = \beta\,(un+1,j - 2un,j + un-1,j) + un,j$$

where

$$\beta = \frac{\lambda}{2\cdot\pi}\cdot\frac{r_{j+1} - r_j}{(\Delta s)^2}$$

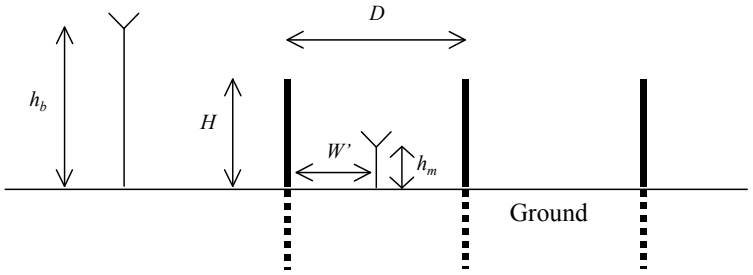
The arc distance, *Ds*, is constant and here set to 5 m. The values of *u* are always between 0 and 1, representing the definition of the coordinate system for the multiple knife-edge case.

The distances r_j and r_j+1 in the following illustration are measured from the radio source to the respective screens.



Parameters for Calculating Pathloss

For calculating the electric field u, the algorithm requires the base antenna and mobile antenna heights, screen heights, and screen locations. Important model parameters for determining u and thus for calculating the pathloss are described in the following illustration:



Two kinds of screens are used to describe the profile:

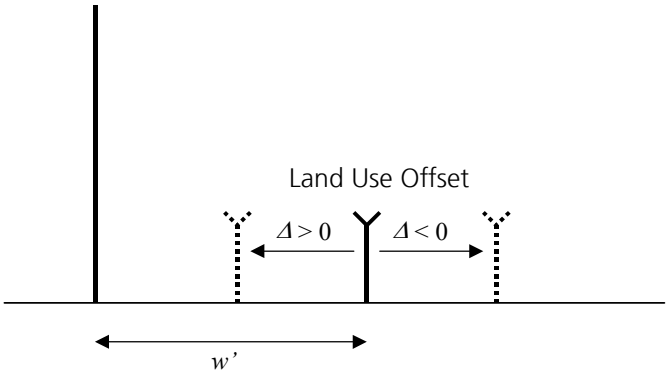
- Permanent screens placed in a statistical way define the environment along the calculation profile in a general way
- Temporary screens placed in a deterministic way describe details of the environment more accurately, near the mobile antenna

When defining a path along an area with vegetation, the location of each screen does not have to coincide with the actual placement of trees and shrubbery; they are placed in a more statistical way. The height of the screens should coincide with the average height of the vegetation. When a building database is used, the values

for heights and locations of the screens are taken from the database and are set in a deterministic way.

Land Use Offset

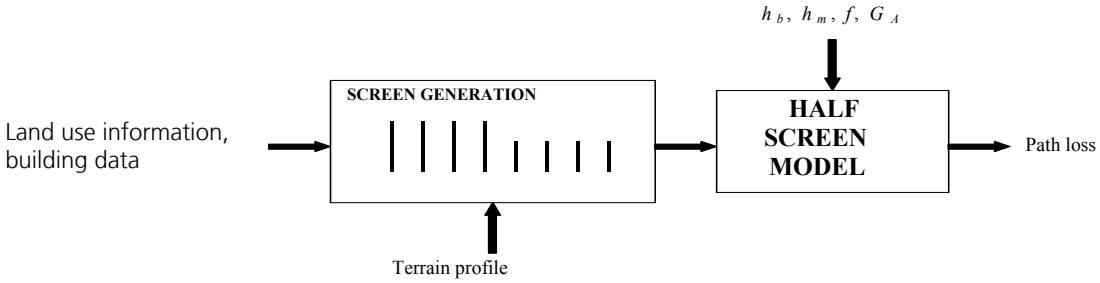
The algorithm translates the distance between the screen and mobile, *w'* to a land use offset value *D*, expressed in dB. The land use offset parameter *D* can be used for model tuning. A land use offset value of 0 dB corresponds to a *w'* value set to its default value, such as 50 m.



Setting *D* to a positive value means that *w'* is decreased. The mobile is moved closer to the screen, and thus the pathloss increases. On the other hand, setting *D* to a negative value means that the mobile is moved farther away from the screen, and the pathloss decreases.

Environmental Data

The following illustration shows the Half-Screen model use of environmental data.



Required Data Input

The following input data are required for the Half-Screen algorithm:

- Base antenna height *hb*
- Mobile antenna height *hm*
- Frequency *f*
- Antenna diagram ΓA (horizontal and vertical pattern)
- Terrain data
- Land use data

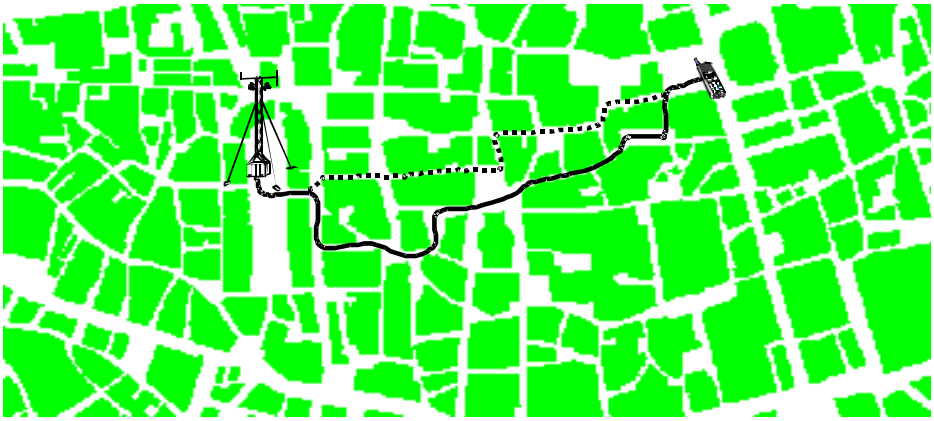
The terrain profile is corrected due to the curvature of earth.

You can use a building database for increased prediction accuracy. The algorithm uses the building database, the land use information, and the terrain database to generate the screen profile used in the calculations. If no building data is available, the screen profile is generated using the land use database and the terrain database.

2.3.2 Recursive Micro Cell Model Propagation Algorithm

The Recursive Micro Cell model calculates the propagation between buildings along streets. The exact locations of buildings, according to the building database, are used for defining the propagation paths. The pathloss is calculated by determining the illusory distance between transmitter and mobile in a street system.

The following figure shows that different propagation paths can occur along the streets between the transmitter and the mobile.



Pathloss Between Buildings

The pathloss between buildings in dB, L_{below}, is given in the following formula:

$$L_{below} = 20 \cdot log\left(\frac{4 \cdot \pi \cdot d}{\lambda}\right)$$

where

Variable	Description
d	The illusory distance between transmitter and receiver [m]
l	The wavelength [m]

Illusory Distance Between Transmitter and Receiver

The illusory distance *d'* is determined by a recursive method, using input data from a map database, as shown in the following formula:

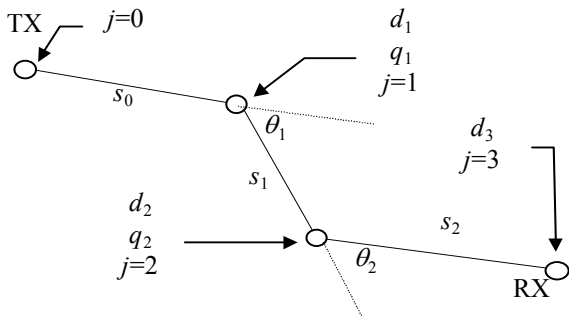
$$\begin{cases} k_j = k_{j-1} + d_{j-1} \cdot q_{j-1} \\ d_j = k_j \cdot s_{j-1} + d_{j-1} \end{cases}$$

where

Variable	Description
q_j	Parameter describing the angle dependence of the pathloss
s_j	Distance between the nodal points *j* and *j+1*
d'_j	Illusory distance, initial value $d'_0 = 0$
k	Help parameter, initial value $\kappa_1 = 1$

Example Street Orientation

The following illustration shows how the variables are used in calculating the path between the transmitter and mobile along the streets.



Angle Dependence Parameter

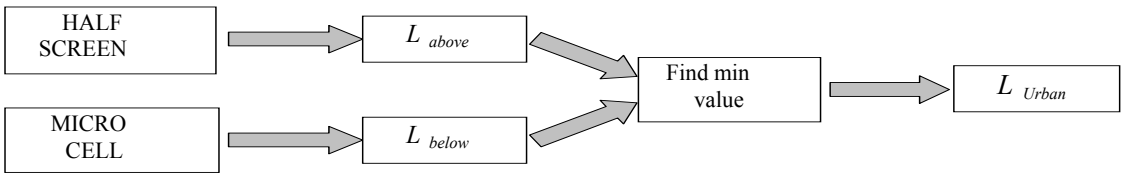
The angle dependence parameter θφ is modeled as shown in the following formula:

$$q_j(\theta_j) = \left(\theta_j \cdot \frac{q_{90}}{90}\right)^{\nu}$$

Here q_j is the corner angle in the nodal point j. q_{90} and n are tuning parameters, set to 0.5 and 1.5, respectively.

Urban Model Pathloss

The Half-Screen model generates the pathloss L_{above}, and the Micro Cell model generates the pathloss L_{below}. As shown in the following figure, the minimum of the two pathloss values is used in determining the Urban model pathloss.



The pathloss for the Urban model is expressed in the following formula:

$L_{Urban} = \min(L_{below}, L_{above})$

In the neighborhood of the base station and in line-of-sight streets, the Micro Cell model dominates. In other cases, only the Half-Screen model contributes to the pathloss.

The formula is an approximation. In a real situation, the radio waves propagate both ways, and the received signal strength is a sum of both contributions. In most situations, one of the propagation paths dominates, and the effect of the approximation is small.

The resulting signal strength is a function of the calculated pathloss, the output power from the transmitter, and the pattern of the base station antenna. During an area prediction, the signal strength values are stored in results where every bin is assigned a certain value. In the presence of a building database, the signal strength values are removed from bins defined as "building." Signal strength values for these bins are calculated with the building penetration algorithm described in the Building Penetration model propagation algorithm.

2.3.3 Building Penetration Model Propagation Algorithm

Penetration Loss

The pathloss in dB between a base station antenna placed outdoors and a mobile placed inside a building is shown in the following formula:

$L_{inside} = L_{outside} + We + s\alpha$

where

Variable	Description
We	The penetration loss through the external wall [dB]

Variable	Description
s	The distance inside building [m]
a	The building penetration slope [dB/m]

Outside Pathloss

$L_{outside}$ [dB] is the pathloss in a point located just outside the external wall, as shown in the following formula:

$L_{outside} = \max[L\Upsilon\rho\beta\alpha\nu\ ,\ \Lambda\phi\sigma\pi(\delta) + W\Gamma\varepsilon]$

Λ_{urban} is the pathloss calculated with the conceptual Urban model and W_{Ge} is the increased wall loss [dB] at a small grazing angle. $\Lambda^{fsp(d)}$ is the free space propagation loss [dB] from the transmitting antenna to the external point.

Urban Model General Parameter Settings

The following table describes the general parameters of the Urban model and the recommended settings.

Parameter	Description	Recommended Setting
Frequency [MHz]	Frequency of the model	ϕ is set according to the actual project in MHz
Mobile Height [m]	Height of the mobile receiver above ground	$\eta\mu$ = 1.5
Earth Radius [km]	The radius of the earth multiplied with the *K* factor, such as 4/3	KP0 = 8500 km

Urban Model Pathloss Parameter Settings

The following table shows the pathloss parameters and recommended settings.

Parameter	Description	Recommended Setting
Max Loss Horizontally [dB]	Maximum pathloss calculated by the recursive micro cell model	Λ_{below} and state of recursive micro cell model: • Λ_{below} (0 dB) = Off • Λ_{below} (100 - 200 dB) = On
Effective Street Width Limit [m]	Minimum distance between screen and mobile	*WL* = 50 m
Base To First Screen Distance [m]	Distance between the base antenna and the first screen	*B* = 25 m
Resolution Distance [m]	Resolution of the prediction with the half-screen model	*R* depends on the prediction radius
Through Wall Constant [dB]	Building penetration loss through the wall	*We* = 5 - 10 dB

Parameter	Description	Recommended Setting
Graze Wall Constant [dB]	Extra wall loss at a small grazing angle	*WGe* = 10 - 20 dB
Building Penetration Slope [dB/m]	Rate at which the signal decreases inside a building	α = 0.3 - 1.0 dB/m

Urban Model Land Use Parameter Settings

The following table shows land use parameters and recommended settings.

Parameter	Description	Recommended Setting
Offset [dB]	Extra loss or gain due to effects in a near environment of the mobile	Δ = 0 dB A negative offset value decreases the effects of knife-edge diffraction (or shadowing). A positive value increases the effects.
Height [m]	Height of the screens associated with the land use type	A value that coincides with typical obstacle height for the land use type. The algorithm uses height values in the digitized map database. If there are none, it uses values specified in the height field of the land use parameters.
Land Use Separation [m]	Distance between screens	*D* = 100 m

2.4 Okumura-Hata Propagation Model

The Okumura-Hata model is similar to both the 9999 model and the Standard Macrocell model.

The Okumura-Hata model should be used as a complement to the 9999 model. It is especially suited to projects where models of Okumura-Hata type, such as the Standard Macrocell model, have been used. The translation between this model and the Okumura-Hata model is easier and gives a more exact result than when translating to the 9999 model.

The Okumura-Hata model may give poor results for specific terrain situations where the 9999 model will do well.

Valid Ranges

The Okumura-Hata model is valid for the following ranges:

- 150 ≤ F ≤ 2000 MHz
- 1 ≤ d ≤ 100 km
- 30 ≤ hb ≤ 200 m
- 1 ≤ hm ≤ 10 m

Required Map Data

It demands the following map data:

- Height information
- Land use (clutter) data

OH Model Pathloss Equation

The pathloss in [dB] given from the Okumura-Hata model is described as:

$$L_p = \max\left(L_1, L_2\right) + L_3 + L_{clutter}$$

A variant of the pathloss equation is:

$$L_1 = C0 + \left(C1 - C2 \cdot \log\ H_e + C3 \cdot \log\ D\right) \cdot \log\ D - C4 \cdot \log\ H_e -$$

$$- C5 \cdot \left(\log\ F\right)^2 + C6 \cdot \log\ F + C7 - L_m$$

where

Variable	Description
D	Distance between base antenna and mobile [km]
H_c	Effective base antenna height [m]
F	Frequency [MHz]
L_m	Mobile height loss:

Mobile Height Loss Equation

L_m is the mobile height loss, shown in the following equation:

$$L_m = \begin{cases} 3.2 \cdot (\log(11.75 \cdot H_m))^2 - 4.97 & \text{urban areas} \\ (1.1 \cdot \log F - 0.7) \cdot H_m - (1.56 \cdot \log F - 0.8) & \text{other areas} \end{cases}$$

where

L_m is the mobile antenna height [m]

Free Space Loss Equation

L_2 is the free space loss, shown in the following equation:

$$L_2 = C8 + 20 \cdot \log F + 20 \cdot \log D$$

Knife-Edge Diffraction Equation

L_3 is the additional loss due to diffraction. This loss is non-zero when line of sight is not available between the base antenna and the mobile, shown in the following equation:

L_3 = C9 * (knife-edge diffraction loss)

$L_{clutter}$ is an extra offset term that can be set to different values for different land use code types. This extra offset is a function that calculates an average value of all clutter losses on the radial.

Recommended Values for Hata Classes

The following table describes recommended values for different Hata classes

Parameter	Urban	Suburban	Rural	COST231_ URBAN	COST231_ SUBURBAN
C0	69.55	59.96	28.61	49.3	46.3
C1	44.9	44.9	44.9	44.9	44.9
C2	6.55	6.55	6.55	6.55	6.55

Parameter	Urban	Suburban	Rural	COST231_ URBAN	COST231_ SUBURBAN
C3	0.0	0.0	0.0	0.0	0.0
C4	13.82	13.82	13.82	13.82	13.82
C5	0.0	2.0	4.78	0.0	2.0
C6	26.16	31.95	44.49	33.9	33.9
C7	0.0	0.0	0.0	0.0	0.0
C8	32.44	32.44	32.44	32.44	32.44
C9	0.5	0.5	0.5	0.5	0.5

When using the Hata class URBAN parameter setting, the equation is equal to the original Okumura-Hata formula. In this case, the mobile height loss is set according to the "urban areas" option.

Effective Antenna Height

The effective antenna height is calculated using the slope method. The effective antenna height is the perpendicular distance between top of the base station antenna and a line that has a slope *m* and passes through the base of the mobile (a point on the ground/terrain where the mobile is standing). *m* is the slope of the line joining the two points on the ground/terrain.

These two points are found in the following way:

1. First the reflection point on the ground is found (for radio waves travelling from top of the base station antenna and top of the subscriber antenna) assuming flat terrain. Then the two centre points are found:
   - Between reflection point and base of base antenna assuming flat terrain

     and
   - Between reflection point and base of mobile assuming flat terrain.
2. Then the two points are projected on to the actual terrain to obtain the two points required to find the slope m.

Knife-Edge Diffraction

The knife-edge diffraction is calculated using the Bullington method:

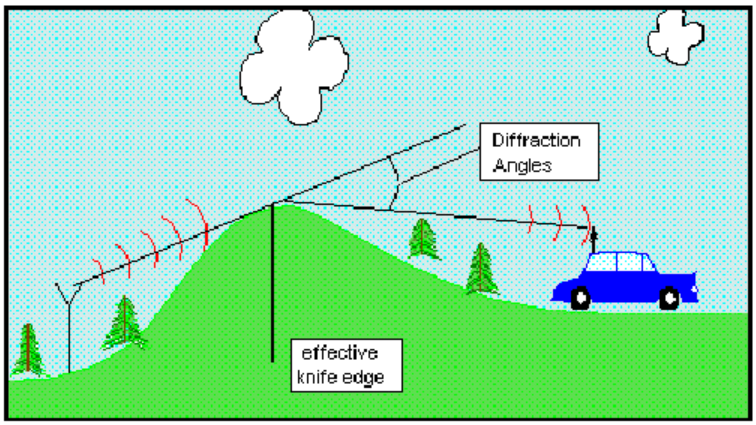
1. The two largest obstructions between the base antenna and the mobile are found. The obstruction penetrates first Fresnel zone such that the ratio of penetration to the Fresnel zone radius at that point is more than 0.55.
2. A knife-edge is formed from the two best obstructions using the Bullington method. If there is one obstruction, then that itself is the knife-edge.
3. From the knife-edge obstruction (the ratio of actual penetration to Fresnel radii at the obstructing edge), the diffraction loss is obtained using look-up tables for obstruction values from 0.55 to 2.0 and 2.0 to 10.0.

For knife-edge obstruction bigger than 10.0 the following formula is used for calculating the loss:

knife-edge diffraction loss = -20 · log (obstruction) - log (2p · 20)

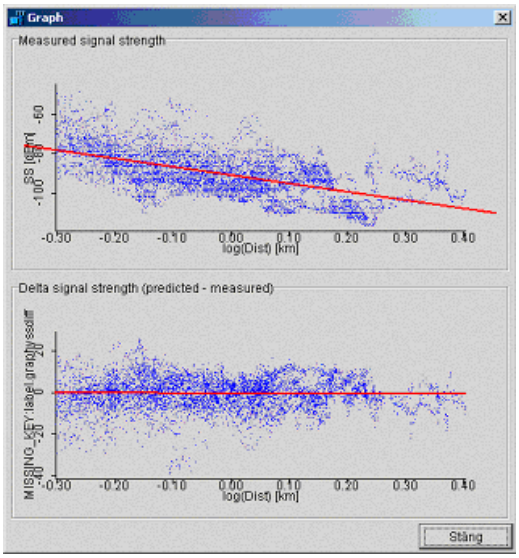
Adjusting Knife-Edge Diffraction Effect

The Okumura-Hata parameter, C9, can be used to adjust the effect of the predicted knife-edge loss. The diffraction loss is computed by using Bullington's approximation in the case of multiple knife-edges, and Lee's equation for determining the additional loss due to the presence of the knife- edge. In some cases, this computed loss can be more pessimistic than results obtained from measurements. If so, use a value of C9 less than 1 to adjust the diffraction effect.



Tuning the Okumura-Hata Model

The Okumura-Hata model can be tuned by adjusting the C1 parameter together with the $L_{clutter}$ values of land use code types. The C1 parameter value should be set so the straight red line in the "Delta signal strength (predicted-measured)" graph is parallel to the *x*-axis (log(Dist) [km]), as illustrated in the following:



The land use code parameters should be set so that the mean errors become zero for each land use type and the over all mean error becomes zero.

2.5 Walfish-Ikegami Propagation Model

The Walfish-Ikegami model is much simpler than the Urban model and does not demand building data. It may give poor results for specific area types where the Urban model will do well.

The Walfish-Ikegami propagation model works best when there is flat ground and built-up areas with uniform building heights and building separations.

The Walfish-Ikegami model should be used as a complement to the Urban model.

Required Map Data

The Walfish-Ikegami model demands height information to calculate effective antenna height and knife-edge diffraction.

The model is especially suited when there is no building database. The map resolution must be high (below 10 - 20 m), since the result deteriorates for low resolution data.

Valid Ranges

The Walfish-Ikegami model is valid for the following ranges:

- $800 \leq F \leq 2000$ MHz
- $0.2 \leq d \leq 5$ km
- $4 \leq hb \leq 50$ m
- $1 \leq hm \leq 3$ m

Pathloss Equation

The pathloss in [dB] given from the Walfish-Ikegami model can be described as:

$L_p = L_0 + L_{rts} + W_9$ ***(knife-edge diffraction loss)**

Free Space Loss Equation

The free space loss equation:

$$L_0 = W0 + 20 \cdot \log F + 20 \cdot \log D$$

where

Variable	Description
D	The distance between base antenna and mobile [km]
F	The frequency [MHz]

Multiple Screen Loss Equation

The multiple screen loss, described as:

$$L_{mul} = L_{bsh} + K_a + K_d \cdot \log D + K_f \cdot \log F - 9 \cdot \log W7$$

Base Station Height Loss Equation

The base station height loss:

$$L_{bsh} = \begin{cases} -18 \cdot \log\left(1 + H_c - W8\right) & \text{if } H_c - W8 > 0 \\ 0 & \text{if } H_c - W8 < 0 \end{cases}$$

where

H_c is the effective base antenna height [m]

Pathloss for Base Antennas Below Rooftops Equation

The equation represents the increase of the pathloss for base antennas below the rooftops of the adjacent buildings:

$$K_a = \begin{cases} W1 & \text{if } H_c - W8 > 0 \\ W1 - 0.8 \cdot \left(H_c - W8\right) & \text{if } H_c - W8 < 0 \text{ and } D \geq 0.5 \\ W1 - 1.6 \cdot \left(H_c - W8\right) & \text{if } H_c - W8 < 0 \text{ and } D < 0.5 \end{cases}$$

Multi-Screen Diffraction Loss vs. Distance Equation

Controls the dependence of the multi-screen diffraction loss versus distance:

$$K_d = \begin{cases} W2 & \text{if } H_c - W8 > 0 \\ W2 - 15 \cdot \left(H_c - W8\right)/W8 & \text{if } H_c - W8 < 0 \end{cases}$$

Multi-Screen Diffraction Loss vs. RF

Controls the dependence of the multi-screen diffraction loss versus radio frequency:

$$K_f = -4 + 0.7 \cdot \left(F/925 - 1\right)$$

Rooftop-to-Street Diffraction Loss Equation

The rooftop-to-street diffraction loss:

$$L_{rts} = -8.2 - W3 \cdot \log W6 + W4 \cdot \log F + W5 \cdot \log (W8 - H_m)$$

where

L_{rts} is the mobile antenna height [m]

Parameter Settings

The parameters W0 - W9 should be set to recommended values as described in the following table:

Parameter	Description	Value range	Default value
W0	Free space loss correction	20 - 60	32.4
W1	Reduced base antenna height correction	30 - 70	54
W2	Range correction	5 - 35	10
W3	Street width correction	3 - 15	10
W4	Frequency correction	3 - 25	10
W5	Building height correction	10 - 30	20
W6	Street width [m]	15 (fixed)	15
W7	Distance between buildings [m]	30 (fixed)	30
W8	Building height [m]	12 (fixed)	12
W9	Knife-edge diffraction loss correction	0 - 1	0.5

Effective Antenna Height

The effective antenna height is calculated using the slope method. The effective antenna height is the perpendicular distance between top of the base station antenna and a line that has a slope m and passes through the base of the mobile (a point on the ground/terrain where the mobile is standing). m is the slope of the line joining the two points on the ground/terrain. These two points are found in the following way:

1. The reflection point on the ground is found (for radio waves travelling from top of the base station antenna and top of the subscriber antenna) assuming flat terrain. Then the two centre points are found:
   - Between reflection point and base of base antenna assuming flat terrain

     and
   - Between reflection point and base of mobile assuming flat terrain.

2. The two points are projected on to the actual terrain to obtain the two points required to find the slope *m*.

Knife-Edge Diffraction

Knife-edge diffraction is calculated using the Bullington method, as described below:

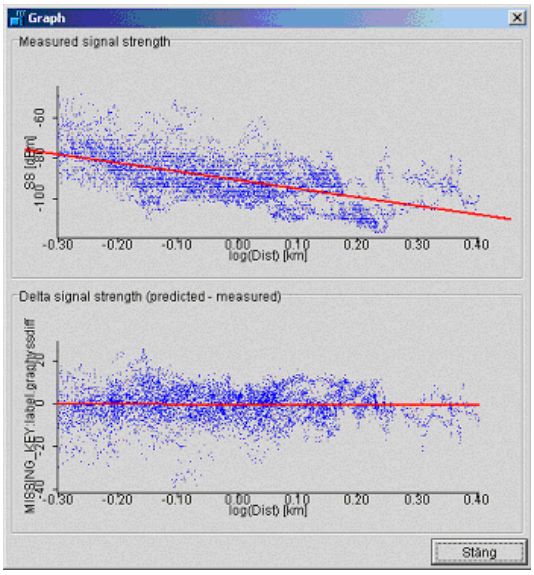
1. The two biggest obstructions between the base antenna and the mobile are found. The obstruction is the one that penetrates first Fresnel zone such that the ratio of penetration to the Fresnel zone radius at that point is more than 0.55.
2. A knife-edge is formed from the two best obstructions using the Bullington method. If there is just one obstruction, then that itself is the knife-edge.
3. From the knife-edge obstruction (the ratio of actual penetration to Fresnel radii at the obstructing edge), the diffraction loss is obtained using look-up tables for obstruction values from 0.55 to 2.0 and 2.0 to 10.0.

For knife-edge obstruction bigger than 10.0 the following formula is used for calculating the loss:

knife-edge diffraction loss = -20 * log (obstruction) - log (2p*20)

Tuning the Walfish-Ikegami Model

The Walfish-Ikegami model can be tuned by adjusting the W2 parameter together with the W1 parameter. Set the W2 parameter value so that the straight red line in the 'Delta signal strength (predicted - measured)' graph is parallel to the x-axis (log(Dist) [km]), as shown in the following graph:



Adjust the W1 parameter so that the overall mean error becomes zero.

2.6 Comparing Okumura-Hata and 9999 Models

The Okumura-Hata model has similarities with both the 9999 model and the Standard Macrocell model.

Comparing the Okumura-Hata model to the 9999 model shows the following:

- In general, the Okumura-Hata model is simpler
- The effective antenna height algorithm is simpler
- The knife-edge diffraction algorithm is simpler
- The spherical earth loss and correction is not considered

This means that the Okumura-Hata model may give poor results for specific terrain situations where the 9999 model will do well.

When to Use the Models

The Okumura-Hata model should be used as a complement to the 9999 model. It is especially suited in projects where models of Okumura-Hata type, such as the Standard Macrocell model, have been used previously. The translation between the Standard Macrocell model and the Okumura-Hata model are easier and give a more exact result than when translating to the 9999. model.

Parameter Comparison

The following table compares parameters and settings for the two models:

Okumura-Hata Model Values	9999 Model Values
C0	A0
C1	A1
C2	A3
C4	A2
C5	4.78
C6	44.491
	mk[mobil]

Other parameters and options for the Okumura-Hata model should be set according to the recommended default settings.

No automatic tuning is included in the Okumura-Hata model, making the propagation model optimization more time-consuming.

2.7 Tuning Propagation Models

The main difference between narrow band propagation and wide band propagation is the influence of fast fading. Since fast fading is normally averaged out during the measurement, it should not be considered. This means that the same measurement equipment used for narrow band propagation can be used for tuning a model for the wide band system.

Perform RF measurements in a specific area to obtain a calibrated model.

Objective of Propagation Model Parameter Calibration

The objective of propagation model parameter calibration is to obtain values for the propagation model parameters and the land use codes that agree with the measured data. When using calibrated parameters, the predicted signal level should have a minimum difference and variance when compared to the measured signal level.

The calibrated parameters are used throughout the area covered by the radio system, including sites that have not been covered by measurements, assuming that similar areas (areas with the same land use code) have the same attenuation due to near field diffraction losses, irrespective of whether measurements had been performed there or not.

Map Data Requirements

For geographical orientation and to make it easier to align sites, it is useful to have in vector format background information such as coastlines, railways, and roads. Text information can also be used. Scanned map backdrops are also very useful when making measurements.

Correct land use code classification is essential.

Requirements for Collecting Measurements

When selecting routes for collecting measurements, consider the following conditions to get the best results.

Condition	Consideration
Transmitter	For the test transmitter, use an Omni antenna with large vertical opening angle. The antenna should not be tilted.
Street orientation	When the mobile is approximately 3 km from the test site, the received signal is affected by the antenna height at the site and the structures and buildings around the site. The difference between two signal strength values, such as one signal received from a street parallel to the test site and the other a street perpendicular to the test site, is about 10 dB. The difference diminishes when the distance from the site increases to approximately 8 km. Sample equal numbers of parallel and perpendicular streets within a 3 km radius from the site to create an unbiased average pathloss slope.
Type of road	Do not take measurements on highways, but plan the routes in narrow streets. Highways are classified as the surrounding land use type, such as suburban, although it is more appropriate to classify them as an open area type. Measuring on highways causes high standard deviation and unexpectedly low attenuation in land use of urban, dense urban, and suburban types. Choose routes well-integrated in the terrain types where the measurements are taken.
Driving route	To collect enough data to do an analysis of the measurement, the routes should be in the range 100 km.
Distance from test site	Do not drive too close to the test sites to collect measurement data. The results for distances closer than 500 m to test sites, especially in an urban environment, are very unreliable.

Model Tuning Process

Tuning a propagation model comprises the following tasks:

1. Set land use offsets to zero for all land use codes.
2. Set default propagation parameters as in previous sections. The default values are the same for 2.05 GHz.
3. Perform a survey analysis.
4. Note the mean error and RMS error/standard deviation.
5. Adjust the land use codes in order to set the mean errors to zero.
6. Set land use codes to new values, for example in the 9999 model, set $A1 = A1 + 0.2$.
7. Perform a survey analysis.

8. Adjust land use parameters so the mean error is zero.
9. Perform a survey analysis.
10. Note the mean error and standard deviation
11. Repeat the process until any change in the values of the land use factors increases the low RMS value.

Repetitions Required

A number of repetitions are required before a near global minimum is obtained. Plot the residual errors to see if they occur in a particular part of the survey or whether they are spread over all the routes. If errors occur over a particular part of the survey, then a close examination of that part is required.

3
Traffic Modeling

This chapter describes the concepts of traffic modeling in TEMS CellPlanner, that is, how to model the bandwidth demand and distribution of terminals and subscribers in the network.

Topics **Page**

Why Traffic Modeling is Needed 3-2
Definitions 3-2
Traffic Modeling Examples 3-3
- Modeling Service Dependency 3-4
- Modeling Different Terminals 3-4
- Modeling Geographical Distribution of Subscribers 3-5

Scale Factor 3-6
- Scale Factor for Uniform Demand 3-6
- Scale Factor for Non-uniform Demand 3-7

3.1 Why Traffic Modeling is Needed

The interference and performance of a network is highly affected by the services and the amount of traffic occurring in the network. The traffic must therefore be modeled as an input to analysis algorithms.

A traffic model based only on the number of subscribers and an estimate of the average bandwidth demand per subscriber could be enough to get a rough indication of the interference and traffic performance in the network.

However, to obtain more realistic analysis results the traffic model should consider that different *services* have different impact on air interface load and interference, that subscribers are using *terminals* of different capabilities, and that the *geographical distribution* of subscribers is most likely uneven.

With TEMS CellPlanner you can define a realistic traffic demand mix, based on your knowledge and assumptions on how the network is or will be used.

3.2 Definitions

The traffic is distributed according to a certain pattern, in TEMS CellPlanner modeled as a *traffic demand mix*. This mix is one of the inputs to the traffic performance and interference analysis.

A **traffic demand mix** combines the *traffic demands* for all services in the network. The traffic demand mix is also a TEMS CellPlanner configuration object. For LTE, WCDMA and WiMAX, you can model asymmetrical traffic load by including traffic demands of different DL and UL rate in a traffic demand mix.

The **subscriber density** is the number of simultaneously active users per square kilometer. In TEMS CellPlanner you configure it either as an average over the entire network (uniform demand) or per land use category (traffic density map).

The **traffic density** is the amount of traffic generated by these subscribers. In TEMS CellPlanner the traffic density is indirectly obtained by combining the configured subscriber density with a configured scale factor. The setting of the scale factor is somewhat complicated, hence it is separately described in section Scale Factor for Traffic Density.

The **traffic demand** is the bandwidth needed for a specific service. The traffic demand is obtained by multiplying the traffic density (some unit per km2, see Scale Factor on page 3-6) with the size of the analysis area. In TEMS CellPlanner the traffic demand is not displayed as a value, but as a configuration object defined per service (bearer).

3.3 Traffic Modeling Examples

The examples below illustrate how to model various traffical aspects in TEMS CellPlanner.

3.3.1 Calculating Subscriber Density

The subscriber density is expressed as the *number of simultaneously active subscribers per square kilometer.*
A re-calculation is needed when the subscriber density is estimated or measured in some other unit, see Scale Factor on page 3-6.

Voice Traffic

This example shows one possible algorithm for calculating voice traffic subscriber density.

Algorithm

sd = (ns* atps) / a

Notation

sd = subscriber density [active subs/km2]

ns = number of active and inactive subscribers [subs]

atps = average traffic per subscriber [Erlangs]

a = analysis area [km2]

Example

We have 2000 active and inactive subscribers in an area of 20 square kilometers.

The average traffic per subscriber is 50 mE (milli Erlangs), thus the probability that a subscriber is active is 0.050.

The resulting subscriber density becomes (2000/20)*0.050 = 5 active subscribers per square kilometer.

Packet Traffic

This example shows one possible algorithm for calculating packet traffic subscriber density.

Algorithm

sd = 20000 / 10000 = td / atps

Notation

sd = subscriber density [active subs/km2]

td = traffic density[bps/km2] = tvbh / a

atps = average traffic per active subscriber [bps/active subs] = nb * bl

tvbh = traffic volume per busy hour [bps]

a = area [km2]

nb = number of bursts per second (and active subscriber) [dimensionless]

bl = burst length [bps]

Example

The total DL traffic demand is 180 megabytes per hour in an area of 20 square kilometers. Hence, the traffic density is $18*10^7*8/(20*3600) = 20000$ bits per second per square kilometer.

An active subscriber receives 10 bursts per second containing an average number of 1000 data bits per burst. An active subscriber thus has an average DL rate of 10*1000 = 10000 bits per second.

The resulting subscriber density becomes 20000/10000 = 2 active subscribers per square kilometer.

3.3.2 Modeling Service Dependency

To consider the service dependency, TEMS CellPlanner models the traffic demand mix as a sum of *traffic demands*. Each traffic demand is defined for a specific bearer, which in its turn models a specific service, which decides the unit of the traffic demand. The basic subscriber density is one subscriber per square kilometer. To obtain the real subscriber density you multiply this density by a configured factor. The unit is implicitly defined by the bearer associated with the traffic demand object.

Example: You have estimated that the traffic density of a voice bearer is five subscribers per km^2. You create a traffic demand and associate it with a voice bearer, supported by the relevant terminals. You set the scale factor to 5. This traffic demand will then contribute to the traffic demand mix with 5 Erlangs/km^2.

3.3.3 Modeling Different Terminals

To model the statistical use of terminals supporting a bearer, TEMS CellPlanner allows you to specify the percentage use of each terminal per traffic demand.

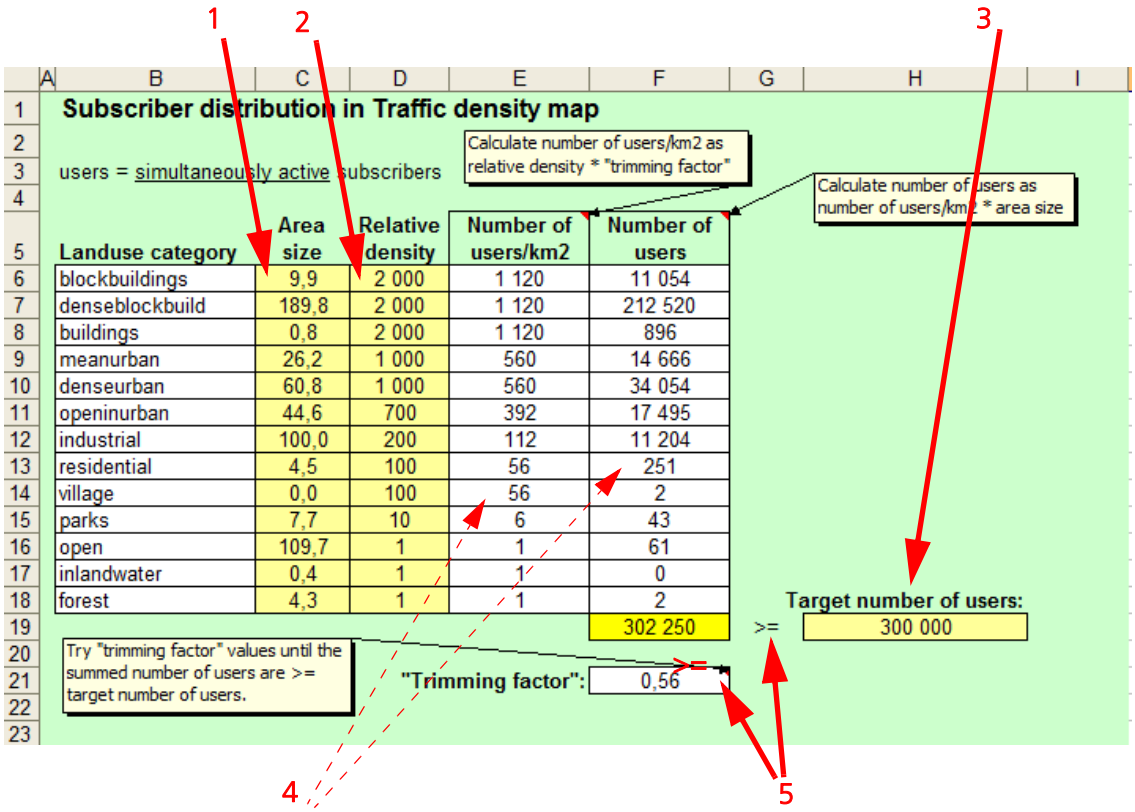
To distribute the traffic on different percentages of indoor and outdoor terminals, use a terminal mix as in the example below. Note that for WCDMA, TEMS CellPlanner creates all plots for an "average terminal" instead of creating separate plots for indoor and outdoor terminals, so a work-around is needed. The work-around consists of creating a duplicate of the bearer and multiplying the scale factors for the two bearers by the indoor and outdoor percentages, respectively.

Example 1: Three terminals - A, B and C - include the voice bearer in their list of supported bearers. You have estimated that the voice traffic derives from terminals of type A in 20% of the cases, terminal B 50% and terminal C 30%. You enter these values in the traffic demand for the voice bearer.

3.3.4 Modeling Geographical Distribution of Subscribers

To model that subscribers are unevenly distributed over the network, TEMS CellPlanner allows you to define a service specific *traffic density map* with a relative density per land use category. The traffic density map is included in the traffic demand of that service (bearer). The subscriber density thus varies between different land use categories.

The example below illustrates how you can calculate the number of subscribers per km^2 for a traffic density map by using a spreadsheet where you enter data for the analysis area:


1
2
3
4
5
Subscriber distribution in Traffic density map
users = simultaneously active subscribers
Calculate number of users/km2 as relative density * "trimming factor"
Calculate number of users as number of users/km2 * area size
Landuse category
Area size
Relative density
Number of users/km2
Number of users
blockbuildings 9,9 2 000 1 120 11 054
denseblockbuild 189,8 2 000 1 120 212 520
buildings 0,8 2 000 1 120 896
meanurban 26,2 1 000 560 14 666
denseurban 60,8 1 000 560 34 054
openinurban 44,6 700 392 17 495
industrial 100,0 200 112 11 204
residential 4,5 100 56 251
village 0,0 100 56 2
parks 7,7 10 6 43
open 109,7 1 1 61
inlandwater 0,4 1 1 0
forest 4,3 1 1 2
302 250
Target number of users:
>=
300 000
Try "trimming factor" values until the summed number of users are >= target number of users.
"Trimming factor":
0,56

1. Area size per landuse category.
2. Relative subscriber density per landuse category, in terms of "how many more subscribers are there in areas of landuse x compared to areas of landuse y". This density does NOT tell the actual number of subscribers per landuse category, but compares densities of landuse categories.

Example: There are 100 times as many subscribers in residential area compared to open area. The relative density of residential area can be set to 100 and open area to 1 (or residential area to 1000 and open area to 10).

3. Target number of users, that is, simultaneously active subscribers in the analysis area.
4. Formulas per landuse category:
   - number of users/km2 = relative density * "trimming factor"
   - number of users =number of users/km2 * area size
5. Try values of "trimming factor" until the summed number of users are equal to or higher than the target number of users.

In case you cannot estimate the geographical distribution for a certain bearer, you select the *uniform demand* option, which disables the possibility to define a traffic density map. The traffic demand implicitly defines the subscribers of this service as evenly distributed over the network.

3.4 Scale Factor

The traffic demand parameter *scale factor* is multiplied with the basic subscriber density. The scale factor is defined differently depending on whether it scales uniform or non-uniform traffic, with special cases for GSM, as outlined below.

Note that any demand expressed as traffic per subscriber shall be **multiplied with the total number of subscribers** (active and inactive) before entering the total demand as a scale factor.

3.4.1 Scale Factor for Uniform Demand

If **Uniform demand** is selected, the basic subscriber density is 1 subscriber/km^2. Multiplying with the scale factor gives the final estimated demand for the bearer. The scale factor shall be assigned as follows:

- GSM CS: Traffic volume per area [Erlangs/km^2]
- GSM PS: Bitrate per area [kbps/km^2]
- WCDMA CS: Simultaneously active users per area [subscribers/km^2].
- WCDMA PS, LTE, WiMAX:
  Simultaneously active users per area [subscribers/km^2].
  The bitrate per subscriber is given by the bearer settings.

3.4.2 Scale Factor for Non-uniform Demand

If Uniform demand is not selected the demand is modeled in a **Traffic density map**. You can further scale the traffic demand by multiplying with the scale factor.

The traffic demand per area of a certain landuse category is given by the scale factor multiplied with Factor in the Traffic density map, resulting in number of users per km^2 (LTE, WCDMA, WiMAX) or number of Erlangs per km^2 (GSM CS), or bitrate per km^2 (GSM PS) for all landuse categories on the map.

As the "per km^2" is already given by the Factor in the Traffic density map, the scale factor shall be assigned as follows for the analysis area:

- GSM CS: Traffic volume [Erlangs]
- GSM PS: Bitrate [kbps]
- WCDMA CS: Simultaneously active users
- WCDMA PS, LTE, WiMAX:
  Simultaneously active users.
  The bitrate per subscriber is given by the bearer settings.

4
Common Algorithms and Parameters

This chapter describes the algorithms and frequency band parameters common to all mobile technologies.

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- Frequency Bands, Channels and Carriers 4-2
- Downlink and Uplink Frequency Bands 4-5
- Workaround to Select Allowed Channels of a Carrier Band 4-6
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4.1 Frequency Band Parameters

The mapping of carriers to channels and frequencies are to a large extent identical for all radio technologies, but the meaning of some parameters vary with the radio technology.

This section illustrates the frequency band parameters common for all radio technologies, and how the parameters relate to each other. The radio technology specific parameters, such as carrier bandwidth and carrier mappings, are described in the user guide of the respective technology.

4.1.1 Frequency Bands, Channels and Carriers

An FDD frequency band is a paired band with separate limits for downlink and uplink, while an S-TDD frequency band consists of one single band for uplink and downlink traffic. In both cases you configure the downlink frequency band only. For FDD the uplink frequency band limits are calculated from the parameter settings, see Downlink and Uplink Frequency Bands.

First you enter the downlink frequency band parameters **base channel, base frequency**, and for some technologies **carrier bandwidth** provided by the operator, see Figure 4–1. The *carrier candidate* is not a parameter, it just illustrates the bandwidth around the carrier frequency.

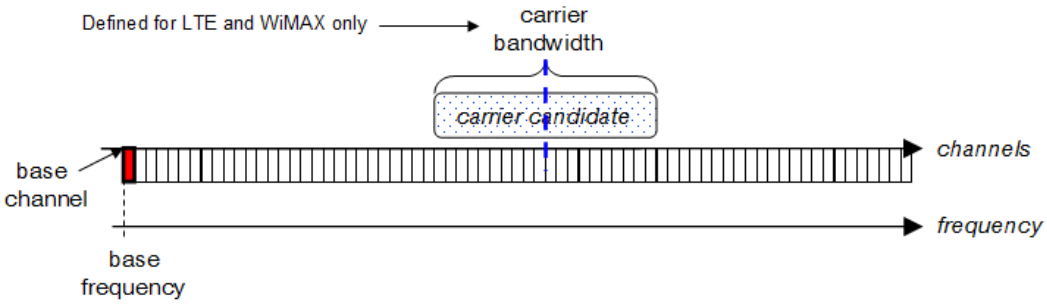

Figure 4–1 Frequency band parameters

Subsequently you configure the downlink parameters of the base sub-band and optionally extra sub-bands. Sub-bands may have different carrier distances. The base sub-band is configured as any sub-band, but with the **base frequency sub-band** option set. Figure 4–2 (LTE and WiMAX) and Figure 4–3 (WCDMA and GSM) illustrate the sub-band parameters.

Carrier overlap should be avoided for LTE and WiMAX. You avoid carrier overlap if the carrier distance is configured as:

carrier distance >= carrier bandwidth / channel separation

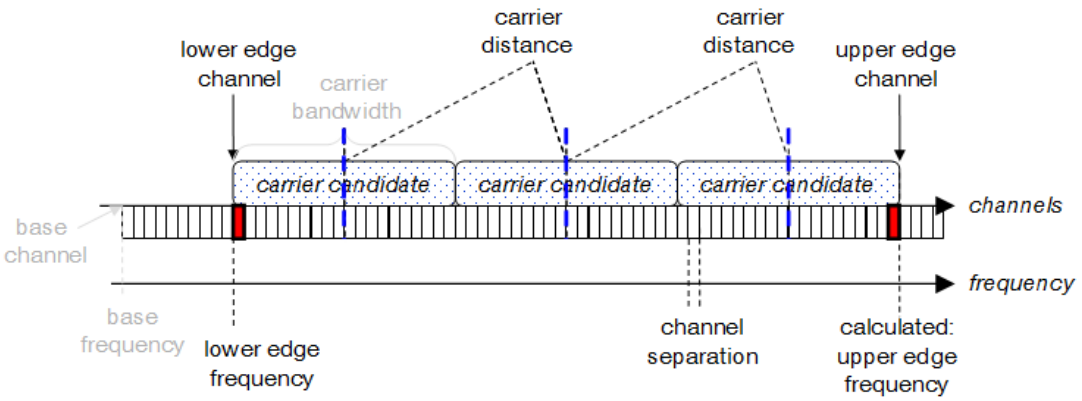

Figure 4–2 LTE and WiMAX sub-band parameters

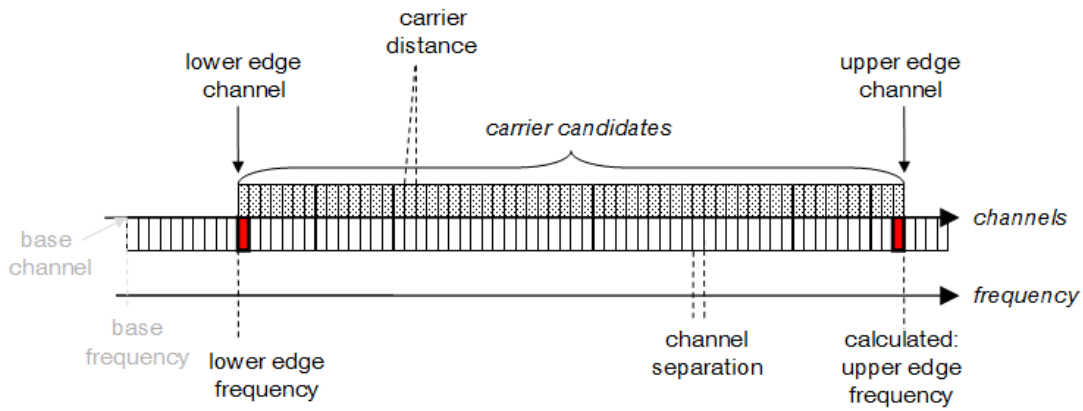

Figure 4–3 WCDMA and GSM sub-band parameters

Finally, you select the channels you want to use as carriers from the list of carrier candidates (LTE and WiMAX Figure 4–4, GSM Figure 4–5) or as downlink UARFCN (WCDMA Figure 4–6).

Each selected channel defines the middle frequency of a carrier, spanning over

$$\left(midfrequency \pm \frac{b}{2}\right)$$

where b = carrier bandwidth. You must select carriers from channels placed at least b/2 from the upper and lower edges of the frequency band.

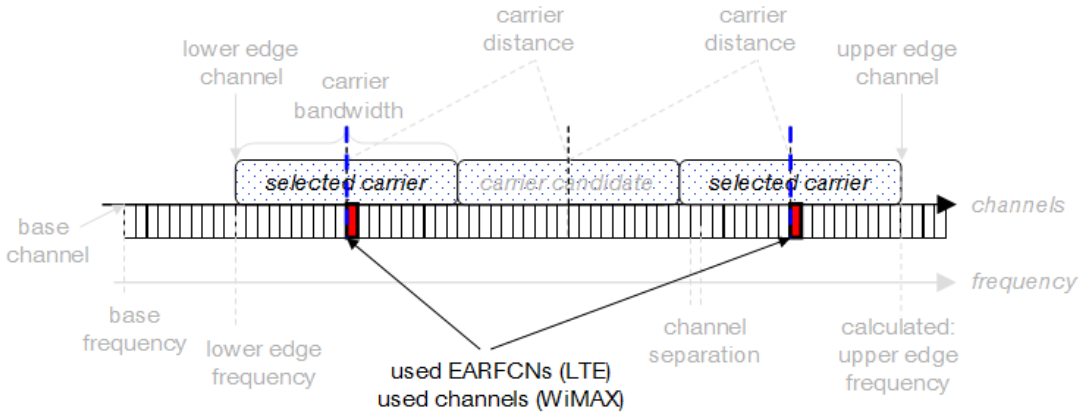

Figure 4–4 LTE and WiMAX channels used as carriers

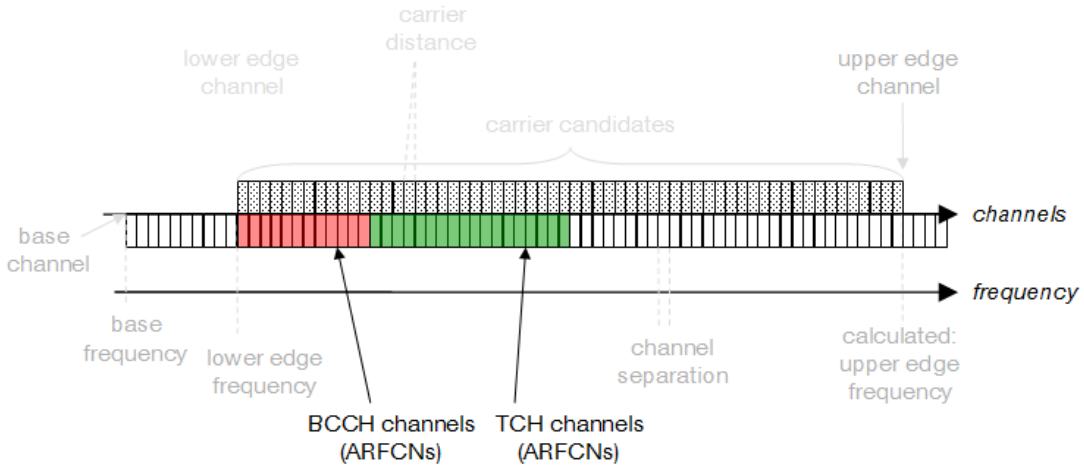

Figure 4–5 GSM channels used as carriers

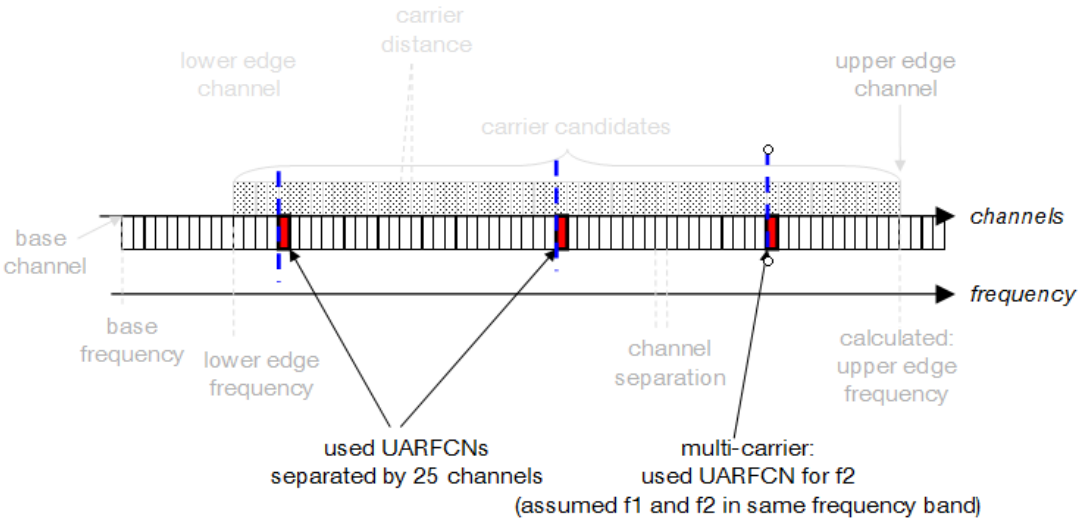

Figure 4–6 WCDMA channels used as carriers

The selected channels can after this be used in cell configurations.

4.1.2 Downlink and Uplink Frequency Bands

The frequency band is a paired band with separate limits for downlink and uplink. You configure the downlink frequency band only. The uplink frequency band is automatically calculated, starting from the lowest downlink frequency minus the duplex distance. The uplink frequency band gets the same carrier bandwidth and number of carriers as the downlink frequency band.

In FDD mode different carriers are used for downlink and uplink. In S-TDD mode, selectable for LTE and WiMAX, the same carrier is used for downlink and uplink, thus the duplex distance is 0. See Figure 4–1 and Figure 4–2.

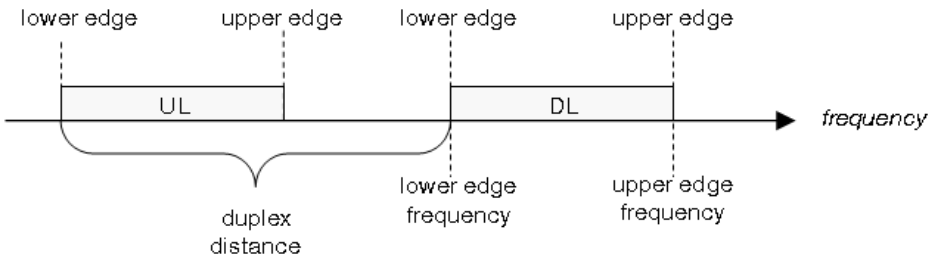

Figure 4–1 FDD frequency band

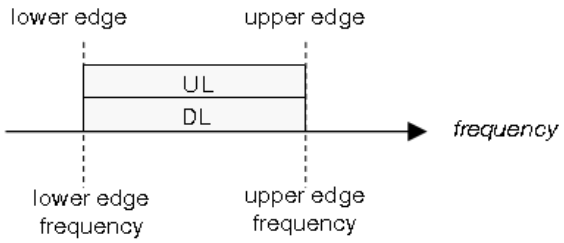

Figure 4–2 S-TDD frequency band

4.1.3 Workaround to Select Allowed Channels of a Carrier Band

The channels listed as carrier candidates in the General tab of the frequency band editor should be the mid channel of each carrier band, but is in the current TEMS CellPlanner implementation the first channel of each carrier band. You must manually ensure that carrier bands only use frequencies within the frequency band, by choosing carrier candidates from channels in the interval:

lower edge channel + (INT(#channels per carrier/2)+1)

up to and including

upper edge channel - (INT(#channels per carrier/2)+1)

where #channels per carrier = carrier bandwidth/channel separation.

An alternative configuration is to set the base channel to at least (lower edge channel + (INT(#channels per carrier/2)+1)), and adjust the base frequency accordingly.

This workaround is needed for LTE, WCDMA and WiMAX, as the carriers in those radio technologies are mid frequencies of a carrier band spanning over a number of channels, while a GSM carrier uses one channel only.

As en example, with a carrier bandwidth of 5 channels/carrier, the following channels are usable as carrier candidates:

lower edge channel + 0x5 + 3, lower edge channel + 1x5 + 3, lower edge channel + 2x5 + 3, and so on, up to upper edge channel + nx5 - 3

4.1.4 Example of a Frequency Band Configuration

The following example illustrates step by step a frequency band configuration in the **System explorer**:

1. Define frequency band parameters as in Figure 4–1. Enter downlink parameters only in the **Frequency band - Advanced** tab:

- base frequency = 2000 MHz
- base channel = 0
- carrier bandwidth = 2 MHz
  (used for LTE and WiMAX only)
- duplex type = FDD, see Figure 4–1
- duplex distance = 100 MHz, see Figure 4–1

2. Define the baseband as in Figure 4–2 in tab **Frequency band - Advanced**:

   - lower edge channel = 10
   - upper edge channel = 69
   - lower edge frequency = 2001 MHz
   - channel separation = 0.1 MHz
   - carrier distance = 20 channels
     (LTE and WiMAX: shall be at least carrier bandwidth * channel separation,
     WCDMA: normally 25 channels,
     GSM: 1 channel, carrier and channel is synonymous for GSM)

3. Automatically calculated parameter (downlink only) as in Figure 4–2 in the **Frequency band - Advanced** tab:

   - upper edge frequency = 2006.9 MHz
     (lower edge frequency + (upper edge channel - lower edge channel) * channel separation)

4. Automatically calculated parameters in the **Frequency band - General** tab:

   DL frequency band used:

   - lower edge = lower edge frequency = 2001 MHz
   - upper edge = upper edge frequency = 2006.9 MHz

   UL frequency band used:

   - lower edge = lower edge frequency - duplex distance = 1901 MHz
   - upper edge = upper edge frequency - duplex distance = 1906.9 MHz

5. Select the channels to use as carriers in the **Frequency band - General** tab, as in Figure 4–4.

4.2 Pathloss Analysis Algorithm

Pathloss analysis generates plots that show the coverage according to the reverse link budget and the site/sector placements and configurations. The algorithm uses terrain data, the RF model, the RF correction, antenna gain, land use, and other factors to build a bin matrix with attenuation to each bin. Pathloss analysis is performed for each individual sector.

When you run Composite Pathloss Matrix (CPLM) analysis, the results from individual sectors are merged into a composite dataset.

4.2.1 Inputs of the Algorithm

Information for pathloss analysis is gathered from a variety of files:

- Terrain file
- Landuse file
- Building data file (for Minicell systems instead of a landuse file)
- Landuse correction file (for extra RF pathloss to be added to specific land use categories)
- Projection file
- Pathloss parameter file
- SystemInfo, a binary file that contains sector and site information

The pathloss parameter file in ASCII format describes the system and user's preferences about the link budget, as shown in the following table:

Factor	Description
Delta X	Bin size value on X-axis. This value is currently equal to that on the Y-axis.
Delta Y	Bin size value on Y-axis. This value is currently equal to that on the X-axis.
Bin Size Units	An enumerated value.
Subscriber Height	In meters
Building Penetration Loss	Used by the Minicell system
Vertical Edge Diffraction Flag	Used by the Minicell system
Max Pathloss	Largest loss to be considered relevant in the final composite dataset.
Max Delta Loss	Greatest difference between the smallest and largest pathloss values in the composite dataset.
Max Number of Cells	Maximum number of cells that can contribute to the pathloss at any one bin in the composite dataset.

The SystemInfo file contains data specified for the system used in the calculations, as described in the following table.

Area	Data
System Data	Technology
	Market boundary, bin size, and units
	Site list
	Antenna list
	Frequency used for pathloss calculation
Site Data	Site location in 3D and units
	Sector list
Sector Data	Sector ID
	Maximum analysis radius
	Center line height in meters
	Transmit look-direction in degrees
	Transmit down tilt in degrees
	Transmit down tilt type: mechanical or electrical
	Transmit antenna data
	Receive antenna data
Antenna Data	Height
	Gain

Data used in the pathloss analysis are as follows.

Data	Description
Frequency	WCDMA pathloss analysis uses the downlink frequency. The RF propagation range decreases with an increase in frequency, and the downlink is at a higher frequency than the uplink. The downlink frequency is used in pathloss analysis because it produces a more conservative propagation estimate. The downlink frequency is derived from the channel assignment to each cell. Since the RF propagation range decreases with an increase in frequency, and the downlink is at a higher frequency than the uplink, using the downlink frequency produces a more conservative estimate of propagation. The nominal frequency is the average or center frequency between the downlink and uplink frequencies as defined by the following formula: $F_{nom} = (F_{down} + F_{up}) / 2$ For AMPS or GSM systems, pathloss analysis uses the nominal transmit frequency specified for all computations.
Building data	For a minicell system, pathloss analysis uses building data instead of a landuse file and includes building penetration loss in the calculations.
RF propagation model	The propagation model is selected on a per-cell basis.
Analysis radius	The radius around a sector used for pathloss analysis is specified in the **Pathloss prediction** window.
Antenna gains	TEMS CellPlanner includes effective antenna gains in the pathloss calculation, generated on a per-cell basis. The following formula shows the pathloss formula used. pathloss = propagation pathloss – effective directional antenna gain + RF correction in land use Pathloss is displayed in units of dBi to show that it includes gains relative to an isotropic antenna. If you make any antenna-related changes to cells, the pathloss results are invalid and you have to run pathloss analysis again.

Pathloss calculations and the composite pathloss matrix (CPLM) contain propagation loss and antenna gain/loss, which are assumed to be reciprocal. Generally, the RF loss is derived from the equipment in the antenna branch and the defined diversity gain. The antenna branch may be of three types.

Branch	Function
Tx branch	Transmits only in the downlink.

Branch	Function
Rx branch	Receives only in the uplink.
TxRx branch	Transmits and receives

The equipment in the antenna branch may be of three types, disregarding the antenna itself, which is not accounted for.

Equipment	Function
Feeder	Has a loss depending on the feeder length and the frequency band used.
Feeder coupler	Has a fixed loss for models, such as a 3 dB connector, a combiner, or a multicoupler.
Tower mounted amplifier (TMA)	Has a gain in the uplink and a loss in the downlink.

Only the equipment included in the antenna branch is considered. You may override the calculated values and set a loss in the uplink and the downlink respectively.

Uplink Calculations

The antenna branch is of type Rx or RxTx. The loss in the uplink is derived as follows.

If override

$$L_{UL} = - \text{DiversityGain} + \text{OverrideLoss}_{UL}$$

else

$$L_{UL} = - \text{DiversityGain} + \text{EquipmentLoss}_{UL}$$

Where the equipment loss is

$$\text{EquipmentLoss}_{UL} = \text{FeederLoss} - \text{TMAGain} + \text{FeederCouplerLoss}$$

Downlink Calculations

The antenna branch is of type Tx or RxTx. The loss in the downlink is derived as follows.

If override

$$L_{DL} = OverrideLoss_{DL}$$

else

$$L_{DL} = EquipmentLoss_{DL}$$

Where the equipment loss is

$$EquipmentLoss_{DL} = FeederLoss + TMALoss + FeederCouplerLoss$$

4.3 Composite Pathloss Matrix Analysis Algorithm

The Composite Pathloss Matrix (CPLM) function incorporates pathloss results from individual sectors into a single 3D dataset.

CPLM provides input to the analysis functions of TEMS CellPlanner and uses the following factors in pathloss parameters file:

Factor	Description
Max pathloss (dB)	Largest loss to be considered relevant in the final composite dataset.
Max delta pathloss (dB)	Greatest difference between smallest and largest pathloss values in the composite dataset.
Max number of cells	Maximum number of cells that can contribute to the pathloss at any one bin in the composite dataset.

4.3.1 Pathloss Data Files

Pathloss analysis generates several data files, each with a different type of analysis data, each on a per-cell basis. The data files include a pathloss dataset file and grid files: tau, phi1, phi2, and theta files.

A common header file exists for all grid files pertaining to a cell, and one header file exists for each cell for which the pathloss analysis was run.

File type	Function
phi files	Used during analysis to: • Determine the vertical angle between a subscriber and its serving cell • Calculate the effects of the subscriber's antenna in the vertical plane. For relatively short cell heights, the change in vertical angle between the mobile and its cell are very small more than 1 km away from the site. When *phi* angles are ignored, pathloss errors are introduced, but are restricted to the region immediately surrounding the site. Since errors are introduced by ignoring the subscriber's vertical antenna pattern, we recommend generating *phi* files. The files are required if you intend to overlay drive test data. If disk space is at a premium, turning off phi file generation allows you to trade disk space for prediction accuracy.
Theta files	Used during analysis to: • Determine the horizontal angle between a subscriber and its serving cell • Calculate the effects of the subscriber's antenna For mobile systems, the subscriber antenna is typically uniform in the horizontal plane, so storing the horizontal angle is often wasteful. Directional subscriber antennas are used for WLL systems, and *theta* files are required for accurate analysis.
Tau file	Contains values for *Tau*, the time taken for the signal to travel from the antenna to any bin. The value is used in deciding scrambling codes of the cells.

5
File Formats

This chapter describes the formats of files that can be imported into or exported from TEMS CellPlanner.

Topics **Page**

Generic Import File Format 5-2
OSS-RC Bulk CM File Format 5-4
OSS-RC CNAI File Format 5-10
Filter File Format 5-18
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Asset/TCP4.1 Import Format 5-24
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5.1 Generic Import File Format

The generic import function imports a tab or space delimited ASCII file containing rows where every row contains the same number of columns. The first row in the file specifies what data all columns contain. Any object and any parameter in TEMS CellPlanner can be imported.

5.1.1 Contents of File

An import file does only contain one type of object. This means that, in order to import for example a fully equipped RBSs from scratch, the import has to be performed as many times, and using as many files, as there are number of different types involves to represent that RBS (RBS, Sector, UtranCell, AntennaBranch, AntennaSystem, Antenna, Site, and so forth).

Object Key

The first column is the key and it identifies the object uniquely. The key could be a combination of attributes from the object in question or any of its parents, separated with the "/" character (see examples below).

5.1.2 Object Creation

When an object is created, attributes not present in the import file will receive their default value.

If the created object has a required aggregate, such an aggregate will be created with it's default values.

If the parent for which the created parent is added does not exist in the project, the import module tries to create the missing parent objects depending on whether the option Create missing parents has been selected or not.

While creating objects, mandatory relations which are not present in the import filet o other objects will be prompted, unless the “Guess...” check box is selected.

5.1.3 Data Types

A native type (int, short, float, double, boolean) is supported in native format (e.g., “23”, “-78”, “false”, “44.0”, and so forth).

- Results are written using a comma as the element separator (no spaces or tabs in any element or between elements)
- An enum type is represented with it's string value
- A relation is represented in an import file as the userLabel of the referenced object. When the object doesn't have a userLabel attribute, the objects string representation is used (toString).

5.1.4 Example Generic Import Files

UtranCell.userLabel	primaryScramblingCode	serviceArea
RBS-00001A1	64	SA-1
RBS-00001B1	64	SA-1
RBS-00001C1	64	SA-1
RBS-00001A1	64	SA-1
RBS-00001B1	64	SA-1

Rbs.userLabel/ UtranCell.userLabel	primaryScramblingCode	serviceArea
RBS-00001/Alpha	64	SA-1
RBS-00001/Beta	64	SA-1
RBS-00001/Gamma	64	SA-1
RBS-00002/Alpha	64	SA-1
RBS-00002/Beta	64	SA-1

Rbs.userLabel	antennaSystem	rbsType
RBS-00001	AntSys-00001	"RBS type 1"
RBS-00002	AntSys-00002	"RBS type 1"

5.1.5 File Format

Characteristics of the Generic Import file format:

- One object per row
- Empty rows are ignored
- A row starting with a '#' character is ignored (could be used as comments)
- Column separator depends on user selection:
- Any number of spaces or tab characters
- One TAB character
- One semicolon character

Content Specification

The first row is the content specification. Each column refers to an attribute or a relation in TEMS CellPlanner. The first column is the object key, possibly a composite key as describes above. The format of a column specification is *[type.]name* where *type* is the name of a class in *name* is a name of an attribute or relation in that class.

If type is left out the same type as in the previous column is assumed. The first column must have type specified. A column specification only containing a dash (the character "-") makes the column to be ignored during import.

5.2 OSS-RC Bulk CM File Format

The Bulk CM format is used in Ericsson OSS-RC WCDMA network data.

In this section you find information about the following mappings:

- Mapping of OSS-RC/Bulk CM MOs to TEMS CellPlanner Objects
- Mapping of OSS-RC/Bulk CM Attributes to TEMS CellPlanner Attributes

Source: Bulk Configuration Management specification in the Ericsson CPI Store.

5.2.1 Mapping of OSS-RC/Bulk CM MOs to TEMS CellPlanner Objects

OSS-RC/Bulk CM MO	TCP object	Comment
SubNetwork MOM		
SubNetwork (root)	SubNetwork	Top-level MO
SubNetwork (RNS)	Rnc	MO under top-level MO
Areas	SubNetwork	
Plmn	Plmn	
LocationArea	LocationArea	
RoutingArea	RoutingArea	
ServiceArea	ServiceArea	
ExternalGsmCell	GsmCell	Mapping based on CGI (MCC,MNC,MNC_length, LAC,Cell ID) ***Note:*** *Existing GsmCells only!*
ExternalUtranCell	----	Not supported.
RBS MOM		
MeContext	Site Rbs	
ManagedElement	Rbs	
NodeBFunction	Rbs	
Sector	Sector	
Carrier	UtranCell	
RbsLocalCell	UtranCell	
Equipment	AntennaSystem	
SectorAntenna	Antenna	
AntennaBranch	AntennaBranch	Only branch “A” is imported
ExternalTma	Tma AntennaBranch	
AntFeederCable	FeederCable AntennaBranch	
AuxPlugInUnit	Antenna	
RetuDeviceGroup	Antenna	

RetDeviceSet	Antenna	
RetDevice	Antenna	
RNC MOM		
MeContext	Rnc	
ManagedElement	Rnc	
RncFunction	Rnc	
IubLink	---	Used at import to align UtranCells with corresponding RbsLocalCells
UtranCell	UtranCell	
Rach	UtranCell.rach	
Fach	UtranCell.fach	
Pch	UtranCell.pch	
Hsdsch	UtranCell	
Eul	UtranCell	
MbmsCch	UtranCell.mcch UtranCell.mich UtranCell.mtch64 UtranCell.mtch128 UtranCell.mtch256	
UtranRelation	UtranRelation	
GsmRelation	GsmRelation	

5.2.2 Mapping of OSS-RC/Bulk CM Attributes to TEMS CellPlanner Attributes

Table 5-1 General attributes

General	Bulk CM attribute	TCP attribute
Cell ID	UtranCell.cId	UtranCell.cellIdentity
UARFCN	UtranCell.uarfcnDl UtranCell.uarfcnUl	UtranCell→AvailableCarrier. downlinkNumber
Primary scrambling code	UtranCell. primaryScramblingCode	UtranCell. primaryScramblingCode
Areas	vsDataPlmn.mcc vsDataPlmn.mnc vsDataPlmn.mncLength LocationArea.lac RoutingArea.rac ServiceArea.sac UtranCell.lac UtranCell.rac UtranCell.sac	Plmn.mcc Plmn.mnc Plmn.mncLength LocationArea.lac RoutingArea.rac ServiceArea.sac UtranCell→LocationArea UtranCell→RoutingArea UtranCell→ServiceArea
UTRAN neighbours	UtranCellUtranRelation	UtranCell→UtranRelation
GSM neighbours	UtranCellGsmRelation	UtranCell→GsmRelation

Table 5-2 Antenna equipment attributes

AntennaEquipment	Bulk CM attribute	TCP attribute
Mechanical downtilt	vsDataAntennaBranch. mechanicalAntennaTilt	Antenna. mechanicalAntennaTilt
Electrical downtilt	vsDataRetDevice. electricalAntennaTilt	Antenna. electricalTiltAngle
Feeder cable attenuations	vsDataAntFeederCable. ulAttenuation	AntennaBranch. overrideAttenuationUl
	vsDataAntFeederCable. dlAttenuation	AntennaBranch. overrideAttenuationDl
Tma attenuation/gain	vsDataExternalTma.ulGain	AntennaBranch. overrideAttenuationUl[1]
	vsDataExternalTma. dlAttenuation	AntennaBranch. overrideAttenuationDl

1. FeederCable and Tma attenuation/gain are combined to calculate overrideAttenuation of AntennaBranch.

Table 5-3 Power attributes

Power	Bulk CM attribute	TCP attribute
Primary CPICH power	UtranCell. primaryCpichPower	UtranCell.pcpich. primaryCpichPower
Primary SCH power	UtranCell. primarySchPower	UtranCell.psch.schPower1
Secondary SCH power	UtranCell. secondarySchPower	UtranCell.ssch.schPower2

BCH power	UtranCell.bchPower	UtranCell.bch.bchPower
PCH power	vsDataPch.pchPower	UtranCell.pch.pchPower
PICH power	vsDataPch.pichPower	UtranCell.pch.pichPower
AICH power	vsDataRach.aichPower	UtranCell.rach.aichPower
Max FACH1 power	vsDataFach. maxFach1Power	UtranCell.fach.maxFach1Power
Max FACH2 power	vsDataFach. maxFach2Power	UtranCell.fach.maxFach2Power
Max TX power DL	UtranCell. maximumTransmissionPower	UtranCell.maxTxPowerDl

Table 5-4 Admission attributes

Admission	Bulk CM attribute	TCP attribute
Power admission DL	vsDataUtranCell.pwrAdm	UtranCell.pwrAdm
No.of orthogonal codes	vsDataUtranCell.dlCodeAdm	UtranCell.noOfOrthogonalCodes: noOfOrthogonalCodes = dlCodeAdm *256 / 100
Capacity limit (ASE) DL and UL	vsDataUtranCell.aseUlAdm	UtranCell.aseUlAdm
	vsDataUtranCell.aseDlAdm	UtranCell.aseDlAdm
BE limit, SF=8 (conn) DL	vsDataUtranCell.sf8Adm	UtranCell.sf8Adm
BE limit, SF=16 (conn) DL	vsDataUtranCell.sf16Adm	UtranCell.sf16Adm
BE limit, SF=32 (conn) DL	vsDataUtranCell.sf32Adm	UtranCell.sf32Adm
Cell range	vsDataRbsLocalCell.cellRange	UtranCell.cellRange

Table 5-5 HSDPA attributes

HSDPA	Bulk CM attribute	TCP attribute
Number of HS-SCCH codes	vsDataHsdsch.numHsScchCodes	UtranCell.hsScchCodes
HS-DSCH power margin	vsDataCarrier.hsPowerMargin	UtranCell.hsDschMargin
HS-SCCH max code power	vsDataCarrier. hsScchMaxCodePower	UtranCell.hsScch
Dynamic Code Allocation	vsDataRbsLocalCell. dynamicHsPdschCodeAdditionOn vsDataRbsLocalCell. featureStateHsdpaDynamicCodeAllocation	UtranCell. isDyncodeAllocEnabled
Max number of HSDPA users	vsDataRbsLocalCell. maxNumHsdpaUsers	UtranCell. maxNumHsdpaUsers
Flexible scheduler	vsDataNodeBFunction. flexibleSchedulerOn vsDataNodeBFunction. featureStateHsdpaFlexibleScheduler	UtranCell. isFlexibleScheduler
Max. no. of SF=4 users on UL	vsDataUtranCell.sf4AdmUl	UtranCell. maxNumSFUsersOnU1

Table 5-6 EUL attributes

EUL	Bulk CM attribute	TCP attribute
EUL max UL noise rise	vsDataRbsLocalCell. eulMaxRotCoverage	UtranCell.eulMaxUplinkNoiseRaise
Max E-AGCH power DL	vsDataRbsLocalCell. maxEAgchPowerDl	UtranCell.eagch.eagchPower
Max user E-HICH/E-RGCH power DL	vsDataRbsLocalCell. maxUserEHichERgchPowerDl	UtranCell.ehich.ehichPower UtranCell.ergch.ergchPower
EUL max own cell noise rise	vsDataRbsLocalCell. eulMaxOwnUuLoad	UtranCell.eulMaxOwnCellNoiseRise
Max number of EUL/ HSUPA users	vsDataUtranCell. eulServingCellUsersAdm	UtranCell.eulMaxUsers
2 ms TTI	vsDataNodeBFunction. featureStateEul2msTti	UtranCell.is2msTti

Table 5-7 Evolved HSPA attributes

Evolved HSPA	Bulk CM attribute	TCP attribute
Number of Tx antennas	vsDataCarrier. numberOfTxBranches	UtranCell. numOfTxAntennas
Modulation	vsDataNodeBFunction.supportOf16qam vsDataNodeBFunction.featureState16Qam vsDataNodeBFunction.featureState64Qam	UtranCell. wcdmaModulation
MIMO feature	vsDataUtranCell. transmissionScheme vsDataRbsLocalCell. featureStateMimo	UtranCell.mimoFeature

Table 5-8 MBMS attributes

MBMS	Bulk CM attribute	TCP attribute
MTCH 64 relative power	vsDataMbmsCch.mtch64PowerOffset	UtranCell.mtch64.power
MTCH 128 relative power	vsDataMbmsCch.mtch128PowerOffset	UtranCell.mtch128.power
MTCH 256 relative power	vsDataMbmsCch.mtch256PowerOffset	UtranCell.mtch256.power
MCCH relative power	vsDataMbmsCch.mcchPowerOffset	UtranCell.mcch.power
MICH relative power	vsDataMbmsCch.michPowerOffset	UtranCell.mich.power

Table 5-9 Geodata attributes

Geodata	Bulk CM attribute	TCP attribute
Latitude/longitude	vsDataSector.latHemisphere vsDataSector.latitude	Site.position.north Antenna.position.north
	vsDataSector.longitude	Site.position.east Antenna.position.east
	vsDataSector.geoDatum (always WGS84)	N/A
Height AGL	vsDataSector.height	Antenna.heightAGL
Azimuth	vsDataSector.beamDirection	Antenna.beamDirection
Cell polygon	VsDataUtranCell. utranCellPosition	UtranCell.utranCellPosition

Table 5-10 Custom attributes

Custom Attributes	Bulk CM attribute	TCP attribute
Individual offset	vsDataUtranCell.individualOffset	UtranCell CA[1]
Min quality level	vsDataUtranCell.qQualMin	UtranCell CA
Min Rx level	vsDataUtranCell.qRxLevMin	UtranCell CA
Max Tx power UL	vsDataUtranCell.maxTxPowerUl	UtranCell CA
Min power per RL	vsDataUtranCell.minPwrRl	UtranCell CA

1. CA = Custom Attribute

Table 5-11 External GSM Cells attributes

External GSM cells	Bulk CM attribute	TCP attribute
Cell ID	ExternalGsmCell. cellIdentity	GsmCell.cellIdentity
Location area code	ExternalGsmCell.lac	GsmCellLocationArea
Network color code	ExternalGsmCell.ncc	GsmCell.ncc
Base station color code	ExternalGsmCell.bcc	GsmCell.bcc
BCCH carrier	ExternalGsmCell. bcchFrequency	GsmCell.channelGroups[i].trxs[j]. carrier.downLinkNumber WHERE i,j are such that GsmCell.channelGroups[i].isBcch = true AND GsmCell.channelGroups[i]trxs[j].isBcch = true
MS Max Tx power UL	vsDataExternalGsmCell. maxTxPowerUl	GsmCell.maxTxPowerUl
Min Rx level	vsDataExternalGsmCell. qRxLevMin	GsmCell.qRxLevMin

5.3 OSS-RC CNAI File Format

The CNAI format is the import/export file format of Ericsson OSS-RC for GSM network data.

In this section you find information about the following mappings:

- Mapping of CNAI MOs to TEMS CellPlanner Information Model Classes
- Mapping of CNAI Parameters to TEMS CellPlanner Attributes

5.3.1 “New” and “old” CNAI Format

OSS-RC provides two different versions of the CNAI file format: "old" CNAI format and "new" CNAI format. The two formats convey exactly the same information but they look completely different and are not compatible with each other. OSS-RC supports both formats for the time being, but their preferred format is the “new” CNAI. The “old” (Excel-like) CNAI format is intended to be phased out in a future release of OSS-RC.

Earlier releases of TEMS CellPlanner supported the "old" (Excel-like) CNAI format.
TEMS CellPlanner now supports the “new” CNAI format.
CNAI files used with TEMS CellPlanner 8.1 and earlier versions cannot be imported to TEMS CellPlanner 9.0 and higher versions.

The “new” CNAI file format is described in the Ericsson specification *CNAI, CNA Interface Interwork Description, 1/155 19-APR 901 0143* available in the OSS-RC CPI document library. (The same document number without prefix 1/ describes the “old” CNAI file format).

5.3.2 Abbreviations used in this chapter

CA	Customized Attribute
CGI	Cell Global Identity
CNA	Cellular Network Administration. Application in OSS-RC to configure GSM networks.
CNAI	CNA Interface. Import/export interface of the CNA application.
MO	Managed Object. Object in OSS-RC/CNAI.
OSS-RC	Operations Support System, Radio and Core. Ericsson's network management system for GSM and WCDMA networks.

5.3.3 CNAI MO Hierarchy

The figure below illustrates the MO hierarchy in OSS-RC and its CNAI files.

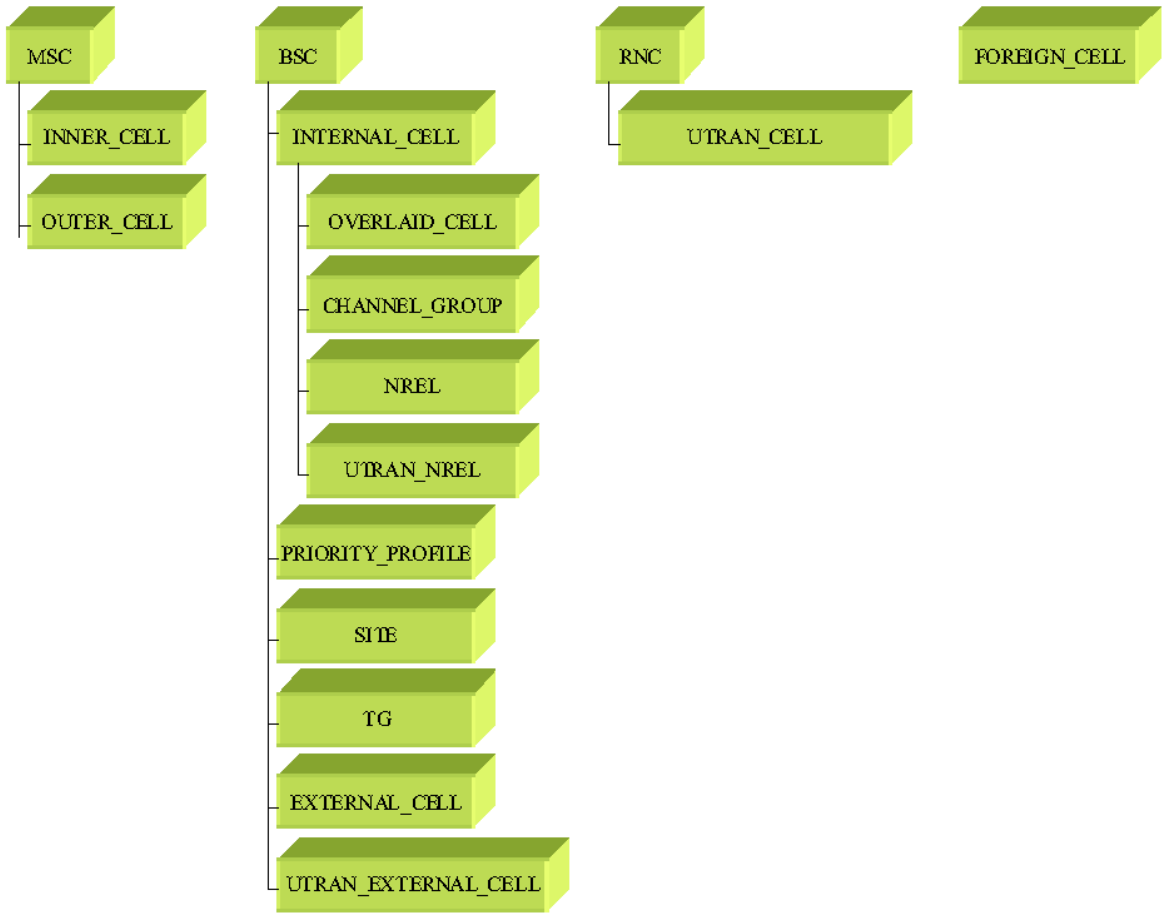


Figure 5–1 CNAI MO hierarchy - zoom in on screen or print out with zooming

5.3.4 Mapping of CNAI MOs to TEMS CellPlanner Information Model Classes

OSS-RC/CNAI MO	TEMS CellPlanner Object	Comment
.subnetwork	Subnetwork	
BSC	GSM BSC	
SITE	Site	
TG	GSM RBS + Transceiver group	CNAI files contain no information on RBSs, only Transceiver groups (TGs). An RBS can consist of one or more Transceiver Groups. For example an RBS2000 consists of one TG, while an RBS200 can consist of up to 3 TGs. Each Transceiver group contains the radio equipment for one or more channel groups, which in turn can belong to one or more cells. TG MOs in CNAI have no configurable parameters. However, they are used in order to interconnect channel groups and sites. Each CHANNEL_GROUP MO is connected to a TG MO, which in turn is connected to a SITE MO. NOTE: TGs are used in OSS-RC GSM Import only to identify the SITE for each INTERNAL_CELL. Note that in CNAI there is direct relationship between SITE and INTERNAL_CELL. In order to identify the SITE for a specific INTERNAL_CELL, one must follow 3 links: INTERNAL_CELL-->CHANNEL_GROUP-->TG-->SITE.
INTERNAL_CELL	GSM cell + Antenna branch + Antenna	Cell name is used to match INTERNAL_CELLs with GSM cells in the project. If no matching GSM cell is found in the project, a new GSM cell will be created.
OVERLAID_CELL	Overlaid sub-cell (+ Antenna branch + Antenna)	In case of a multi-band cell, a separate Antenna branch and Antenna are created for the Overlaid sub-cell.
CHANNEL_GROUP	Channel group	
NREL	GSM neighbor relation	
UTRAN_NREL	UTRAN neighbor relation	Imported only if the target UTRAN cell already exists in the project. See UTRAN_CELL below.
UTRAN_CELL	UTRAN cell	Target cell in one or more UTRAN_NREL. Imported only if the corresponding UTRAN cell already exists in the project. The matching UTRAN cell is identified either by cell name, or, if that is unsuccessful, then by Cell Global Identity: CGI = MCC + MNC + RNCID + CI. If both are unsuccessful, then the UTRAN_CELL is not imported. OSS-RC GSM Import will not create new UTRAN cells in the project.
RNC	RNC	Needed in OSS-RC as parent for UTRAN_CELL MOs. At import, RNC ID is used to identify the matching RNC in the project. If no such RNC is found, then a new RNC is created in the project.
FOREIGN CELL	Not mapped.	
UTRAN_EXTERNAL_CELL	UTRAN cell (Import only.)	Used at import the same way as UTRAN_CELL, in case UTRAN_CELLs are not present in the CNAI file. Not exported. UTRAN_CELL is exported instead.
MSC	Not mapped.	
INNER_CELL	Not mapped.	
OUTER_CELL	Not mapped.	
EXTERNAL_CELL	Not mapped.	

5.3.5 Mapping of CNAI Parameters to TEMS CellPlanner Attributes

The following notation is used in the mapping tables:

- X in the **Imp** column indicates that the CNAI parameter is imported to TEMS CellPlanner
- X in the **Exp** column indicates that the CNAI parameter is exported to OSS-RC
- Parameters not present in the tables are neither imported nor exported.

Table 5-12 BSC parameters

BSC				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
BSC_NAME	Bsc.userLabel	X	X	
EXTCELLNO	Bsc CA	X	-	Maximum number of EXTERNAL_CELLs allowed in this BSC.
EXTHANDOVERNO	Bsc CA	X	-	Maximum number of inter-BSC neighbor relations allowed in this BSC.
HCSBANDn n = 1..8	HCS layer numbers in HCS band n of Bsc	X	X	
HCSBANDTHRn n = 1..8	Band threshold of HCS band n of Bsc	X	X	
INTCELLNO	Bsc CA	X	-	Maximum number of INTERNAL_CELLs allowed in this BSC.
INTHANDOVERNO	Bsc CA	X	-	Maximum number of intra-BSC neighbor relations allowed in this BSC.
OF_GPRS	Bsc.gprsEnabled	X	-	
OF_GPRSCS3CS4	Bsc.gprsCs3Cs4Enabled	X	-	
OF_HCS	Bsc.hcsEnabled Copied to GsmCell.useHcs for each GsmCell in this Bsc.	X	-	
OF_HCSBAND	Bsc.hcsBandEnabled	X	-	
OF_MAIOMANAGEMENT	Bsc.maioEnabled	X	-	
UTRANEXTCELLNO	Bsc CA	X	-	Maximum number of UTRAN_EXTERNAL_CELLs allowed in this BSC.
UTRANNRELNO	Bsc CA	X	-	Maximum number of UTRAN neighbor relations allowed in this BSC.
VENDOR	Bsc CA	X	-	
VERSION	Bsc CA	X	-	BSC version. VERSION = OTHER indicates pre-R11 or non-Ericsson BSC.

Table 5-13 Internal cell parameters

INTERNAL_CELL				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
ACCMIN	(-1) * GsmCell.qRxLevMin Export: (-1)*qRxLevMin < 47 is exported as 47. (-1)*qRxLevMin > 110 is exported as 110.	X	X	Range of ACCMIN is 47-110
ANTENNA_TILT	Antenna.mechanicalAntennaTilt	X	X	BSS R11 and higher

ANTENNA_TYPE	GsmCell-->AntennaBranch-->Antenna-->AntennaType Import: AntennaType is set to the project Antenna type that the user has selected in the Import dialog for this particular OSS ANTENNA_TYPE. Export: IF AntennaType--> AntennaBand.halfPowerBeamWidthHorizontal == 360 THEN ANTENNA_TYPE = OMNI ELSE ANTENNA_TYPE = SECTOR	X	X	Possible values: - OMNI - SECTOR - ADAPTIVE - UNDEFINED ADAPTIVE antennas are not supported in TEMS CellPlanner.
BCC	GsmCell.bcc	X	X	
BCCHNO	Carrier number of BCCH TRX of GSM cell	X	X	
BSC_NAME	GsmCell-->parentBts-->Bsc.userLabel	-	X	
BSTXPWR	GsmCell.txPowerDl	X	X	
CELL_DIR	Antenna.beamDirection	X	X	CELL_DIR = 360 for omni-cell
CELL_NAME	GsmCell.userLabel	X	X	
CI	GsmCell.cellIdentity	X	X	
CP_BCC_TSC	GsmCell.copyBccToTsc	X	X	Possible values: - Chgrp_0, - All.
C_SYS_TYPE	GsmCell.frequencyBand	X	X	Possible values: - GSM800 - GSM900 - GSM1800 - GSM1900
DCHNO	Carriers of Channel group UL_0 of GSM cell. Used only if INTERNAL_CELL has no CHANNEL_GROUPs. DCHNO of CHANNEL_GROUP overrides this parameter.	X	X	Applicable only if BSC VERSION == OTHER (old BSC or non-Ericsson BSC).
DTXD	GsmCell.dtxFactorEnabled	X	X	
DYNBTSPWR_STATE	GsmCell.powerControlEnabled	X	X	

GPRSSUP	GPRSSUP + SCALLOC are used together to set the GPRS option for the Underlaid and Overlaid sub-cells
	Import:
	GsmCell.gprsSupported =
	(GPRSSUP == YES AND SCALLOC != OL)
	GsmOLCell.gprsSupported =
	(GPRSSUP == YES AND SCALLOC != UL)
	
	Export:
	IF (GsmCell.gprsSupported OR
	GsmOLCell.gprsSupported) THEN
	GPRSSUP = YES
	ELSE
	GPRSSUP = NO
		X	X	Indicates whether GPRS is supported in the cell.
				Used together with SCALLOC

HEIGHT	Antenna.heightAGL	X	X	
LAC	GsmCell-->LocationArea.lac	X	X	
LATITUDE	Antenna.position.northing	X (N)	X	(N) Imported only when creating a new cell in the project. Antenna positions of existing cells are not modified.
LAYER	GsmCell-->HcsLayer.layerNumber	X	X	
LAYERTHR	(-1)*GsmCell.hcsLayerThreshold	X	X	
LONGITUDE	Antenna.position.easting	X (N)	X	(N) Imported only when creating a new cell in the project. Antenna positions of existing cells are not modified.
MCC	GsmCell->LocationArea-->parentPlmn.mcc	X	X	
MNC	GsmCell->LocationArea-->parentPlmn.mnc GsmCell->LocationArea-->parentPlmn.mncLength	X	X	

NCC	GsmCell.ncc	X	X	
NCCPERM	GsmCell.permittedNcc	X	-	Import only. OSS-RC sets this parameter automatically based on the NCCs of neighbor cells.

SCALLOC	Import: See GPRSSUP.
	Stored as CA in GSM cell for use during Export.
	
	Export:
	IF GsmCell.gprsSupported THEN
	IF GsmOLCell.gprsSupported THEN
	IF GsmCell.scAlloc == BOTHUL THEN
	SCALLOC = BOTHUL
	ELSE
	SCALLOC = BOTHOL
	ELSE
	SCALLOC = UL
	ELSE
	IF GsmOLCell.gprsSupported THEN
	SCALLOC = OL
	ELSE
	SCALLOC = UNDEFINED
		X	X	Indicates whether GPRS is supported in UL sub-cell, in OL sub-cell or in both.
				Possible values:
				- UL (UL sub-cell only)
				- OL (OL sub-cell only)
				- BOTHUL (both in UL and OL sub-cell, UL is prioritized)
				- BOTHOL (both in UL and OL cell, OL is prioritized)
				
				Note: Currently TEMS CellPlanner cannot distinguish between BOTHUL and BOTHOL. (TEMS CellPlanner traffic analysis always prioritizes the OL sub-cell.) Therefore, the CA is needed to remember if BOTHUL or BOTHOL was used in OSS.-RC

SSOFFSETDL	GsmCell.powerOffset	X	X	
TALIM	GsmCell.maxTimingAdvance	X	X	
TILT	Antenna.mechanicalAntennaTilt = TILT – 90	X	X	BSS R10 only
TSC	Copied to ChannelGroup.tsc for each Underlaid ChannelGroup in cell. Used only if INTERNAL_CELL has no CHANNEL_GROUPs. TSC of CHANNEL_GROUP overrides this.	X	X	
XRANGE	GsmCell.extendedRange	X	X	

Table 5-14 UTRAN cell parameters

UTRAN_CELL				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
CELL_NAME	UtranCell.userLabel	X	X	
CI	UtranCell.cellIdentity	X	X	
FDDARFCN	UtranCell.frequency.downlinkNumber	-	X	
LAC	UtranCell.locationArea.lac	X	X	
MCC	UtranCell.locationArea.aggregatingPlmn.mcc	X	X	
MNC	UtranCell.locationArea.aggregatingPlmn.mnc	X	X	
SCRCODE	UtranCell.primaryScramblingCode	-	X	

Table 5-15 Site parameters

SITE				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
ALTITUDE	Ground height at Site.position (from elevation map data)	-	X	Export only.
BSC_NAME	Site-->Bts-->Bsc.userLabel	X	X	
LATITUDE	Site.position.northing	X (N)	X	(N) Imported only when creating a new Site in the project. Positions of existing Sites are not modified.

LONGITUDE	Site.position.easting	X (N)	X	(N) Imported only when creating a new Site in the project. Positions of existing Sites are not modified.
SITE_NAME	Site.userLabel Bts.userLabel	X	X	

Table 5-16 Transceiver group parameters

TG				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
BSC_NAME	TransceiverGroup-->parentBts--> Bsc.userLabel	X	X	
SITE_NAME	TransceiverGroup-->parentBts-->parentSite.userLabel	X	X	
TG_NAME	Transceiver group.userLabel	X	X	

Table 5-17 Overlaid cell parameters

OVERLAID_CELL				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
BSC_NAME	parentGsmCell-->parentBts-->Bsc.userLabel	-	X	
BSTXPWR	GsmOLCell.txPowerDl	X	X	
CELL_NAME	parentGsmCell.userLabel	-	X	
LOL	GsmOLCell.maxAllowedPathloss	X	X	
SSOFFSETDL	GsmOLCell.powerOffset	X	X	
TAOL	GsmOLCell.maxTimingAdvance	X	X	Note: Only values 0..61 are allowed in Overlaid sub-cell.
TSC	Copied to ChannelGroup.tsc for each Overlaid ChannelGroup in cell. Used only if INTERNAL_CELL has no CHANNEL_GROUPs. TSC of CHANNEL_GROUP overrides this parameter.	X	X	BSS R10 only

Table 5-18 Channel group parameters

CHANNEL_GROUP				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
BAND	Frequency band of parent sub-cell (Underlaid or Overlaid)	X	X	
BSC_NAME	GsmCell-->parentBts-->Bsc.userLabel	-	X	
CELL_NAME	---	-	X	
CHGR_NAME	ChannelGroup.groupNumber	X	X	Range = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
DCHNO	Mapped to carriers of Channel group (in case of Fixed or Baseband hop) or carriers of Frequency group (in case of Synth hop)	X	X	

HOP	Mapped to Hop type of ChannelGroup
	
	Possible values: ON, OFF.
	In case of ON, NUMREQBPC is needed in order to distinguish between BaseBand hop and Synth hop.
	
	Import:
	IF HOP == OFF THEN
	ChannelGroup Hop type = Fixed
	IF HOP == ON AND NUMREQBPC == SYSDEF THEN
	ChannelGroup Hop type = BaseBand hop
	IF HOP == ON AND NUMREQBPC != SYSDEF THEN
	ChannelGroup Hop type = Synth hop
	
	Export:
	IF ChannelGroup Hop type == OFF THEN
	HOP = OFF
	ELSE
	HOP = ON
		X	X	

HSN	ChannelGroup.hsn	X	X	
MAIO	ChannelGroup.maioList	X	X	

NUMREQBPC	Mapped to number of TRXs in ChannelGroup
	
	Import:
	IF NUMREQBPC == SYSDEF THEN
	#TRXs = sizeof(DCHNO)
	ELSE
	#TRXs = NUMREQBPC / 8
	
	Export:
	IF ChannelGroup.hop != ONSY THEN
	NUMREQBPC = SYSDEF
	ELSE
	NUMREQBPC = ChannelGroup.trxs.size() * 8
		X	X	Number of Required Basic Physical Channels.
				1 TRX = 8 BPCs
				
				Value SYSDEF indicates that #TRXs = sizeof(DCHNO).

NUMREQCS3CS4BPC	ChannelGroup.numOfTimeslotGprsCs3Cs4	X	X	
NUMREQEGPRSBPC	ChannelGroup.numOfTimeslotEgprs	X	X	
SCTYPE	IF SCTYPE == UL THEN ChannelGroup is allocated to Underlaid sub-cell ELSE IF SCTYPE == OL THEN ChannelGroup is allocated to Overlaid sub-cell	X	X	
TG_NAME	ChannelGroup-->TransceiverGroup.userLabel Used at import to identify the parent Site for the GsmCell.	X	X	Name of the TG that the CHANNEL_GROUP is connected to.
TSC	TSC of ChannelGroup	X	X	

Table 5-19 Neighbor relation parameters

NREL				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	**Comment**
BSC_NAME	GsmCell-->parentBts-->Bsc.userLabel	X	X	
CELL_NAME	userLabel of source GsmCell	X	X	
NREL_NAME	userLabel of neighboring GsmCell	X	X	

Table 5-20 UTRAN neighbor relation parameters

UTRAN_NREL				
Parameter name	**TEMS CellPlanner attribute**	**Imp**	**Exp**	
BSC_NAME	GsmCell-->parentBts-->Bsc.userLabel	X	X	
CELL_NAME	userLabel of source GsmCell	X	X	
NREL_NAME	userLabel of neighboring UtranCell	X	X	

5.4 Filter File Format

To import filters to TEMS CellPlanner, the file must be in XML, Excel or text format. The table below outlines suitable formats for various contents.

File format	File extension	Filter types	File encoding	Filter mix per file	Included filter properties *	Additional
XML	.xml	Any	UTF-8	Any	Any	
Excel	.xls	• Site filters • Cell filters	UTF-8	Any	Any	Site filters can also be imported from text file
Text	.txt	Site filters	Windows-1252 / WinLatin1	One site filter per file	• Type • Name	

*) The possible filter properties are:

- Filter type
- Filter name
- Description
- Creation date
- Access type

5.4.1 Excel Filter Format

This section describes the format required to import filters in Excel format.

Site filter

Filter type (M)	Site filter
Created (O)	<date and time>
Version (O)	<filter format version>
Name (O)	<a filter name>
Description (O)	<a filter description>
Access type (O)	Shared/User
<Site>(M)	
<a site name>	
<a site name>	
...	

(M) indicates mandatory information, must be present
(O) indicates optional information, not required when importing but present at export

Cell filter

Filter type (M)	Cell filter		
Created (O)	<date and time>		
Version (O)	<filter format version>		
Name (O)	<a filter name>		
Description (O)	<a filter description>		
Access type (O)	Shared/User		
<Site>(M)	<RBS> (M)	<sector> (M)	<cell> (M)
<a site name>	<a bts name>		<a gsmCell name>
<a site name>	<an rbs name>	<a sector name>	<an utranCell name>
<a site name>	<a wimaxRbs name>		<a wimaxCell name>
<a site name>	<an lteRbs name>	<a sector name>	<an lteCell name>
...			

(M) indicates mandatory information, must be present
(O) indicates optional information, not required when importing but present at export

Valid column headers:

<Site>	Site
<RBS>	GSM BTS, WCDMA RBS, Wimax RBS, LTE RBS
<sector>	WCDMA sector, LTE sector
<cell>	GSM cell, WCDMA cell, Wimax cell, LTE cell

5.5 System File Format

To import a system file into TEMS CellPlanner, the file must be an ASCII text file with tab-delimited columns. The system import file format is the same as a system export file format. To start, export an existing system designed with TEMS CellPlanner and edit the information in that file.

5.5.1 Syntax for System File

Use the following syntax for the system file:

- Each column entry can include characters, numbers, or spaces existing between two tab marks.
- Each entry string is stripped of leading and trailing blanks and assigned to the field it represents.
- A string entry can have blanks within the string, such as "Mission Valley."
- If a column is not used or is not applicable, a value must still be entered or it is skipped and all the remaining columns are processed incorrectly.

5.5.2 Required Number of Columns

WCDMA Systems

For a WCDMA system, a total of 47 columns of information is required.

AMPS Systems

For an AMPS system, 33 columns are required.

5.5.3 Content of Header Lines

Line 1

Header line one must contain the following information:

Column	Description
Column A	For WCDMA networks, this string indicates the technology used by this network.
Column B	Frequency in MHz of the band used by the system for RF propagation predictions. • For AMPS, this is the nominal frequency. • For WCDMA, this frequency is translated to the corresponding reverse link channel number, and that channel number is assigned to all sectors. Before determining the channel number, the system also determines the band being used: 800 MHz = cellular, 1900 MHz = PCS.
Column C	For an AMPS system, the block (A or B)

Line 2 to Data Lines

The next several lines can be used for comments, column titles, or miscellaneous entries. Only lines that begin with the word **ON** or **OFF,** followed by a tab mark, are treated as valid sector definition entries.

5.5.4 Content of Data Lines

For each sector, the columns must contain the following data:

Column	Description
Column A	**ON** or **OFF -** a sector that is turned OFF transmits no power and receives no signals.
Column B	**Site Code** - a string up to seven characters long that uniquely identifies this site, such as URB-023**.** No two sites may have the same code.
Column C	**Site Name** - a string up to 63 characters long that more fully describes this site, such as "Downtown, Broadway and 5th".
Column D	**Sector Code** - a string up to seven characters long that uniquely identifies this sector at this site, such as Alpha**.**
Column E	Latitude - the latitude of the site must be specified in the format `dd mm ss N`, as in 32 49 11 N. The seconds (the third number) may be a floating point number with up to two digits after the decimal place, as in `32 49 11.29 N`. Spaces are required between the numbers and before the final N or S. Do not use tabs.

Column	Description
Column F	**Longitude** - The longitude of the site must be specified in the same type of format as the latitude except that the final character is E or W rather than N or S.
Column G	**Ground elev.** - The site's ground elevation in average meters above mean sea level. This field is not required, but if you know the value, you can enter it here.
Column H	**Antenna Code** - This string must match the antenna code or antenna model name of an existing antenna in the antenna database. The entry is not case sensitive. The antenna code field represents either the antenna code (7 characters) or the model name (31 characters).
Column I	Height - The height of the antenna tower and/or building to the radiation center of the antenna, in meters, above ground elevation.
Column J	**Theta** - The antenna azimuth look-direction (degrees), relative to true north.
Column K	**Tilt** - Antenna downtilt (degrees), relative to the horizon.
Column L	**Tilt Type** - Type of downtilt for the antenna. Options are NONE, MECH, or ELEC. Electrical downtilt applies only to omni-directional antennas.
Column M	**Max PA Power** - For a WCDMA system, the maximum PA power (watts) for the sector. For an AMPS system, the power transmitted for each channel.
Column N	**Max Radius** - Maximum analysis radius for this sector (km).
Column O	**RF Model Code** - RF propagation model code used for this sector. This string must match the code given to an existing propagation model in the database, or else it must read **Custom**. Minicell sectors have the special RF model name "MINI-CE". Custom Propagation Models The following entries are required only for **custom** propagation models. However, if a standard RF model is being used, each of these fields must still contain something, such as -1, so that the proper number of columns is maintained.
Column P	**RF model class** - Classes are: Hata, Mod. Hata (modified Hata), Ericsson 9999 and 3 Break Pts. An RF model class defines the way RF model coefficients will be used.
Column Q	through Z: **RF Model Coeff -** For the Hata class model, the ten coefficients correspond, in order, to coefficients C0 through C9.

5.5.5 Adjustments

The following table describes the adjustment data in the system file:

Column	Description
Column AA	**Extra RF losses (dB)** - Use this field to adjust the propagation model slightly for each sector, whether that model is a CUSTOM one or a standard model from the database.
Column AB	**Noise Figure (dB)** - The ratio of the self-noise of the sector to the thermal noise level.
Column AC	**Xmt Losses (dB)** - The transmit losses in dB that may be experienced between the output of the PA and the input into the transmitting antenna.
Column AD	**Rcv Losses (dB)** - The receive losses in dB that may be experienced between the output of the receiving antenna and the input into the demodulator.

5.6 Asset/TCP4.1 Import Format

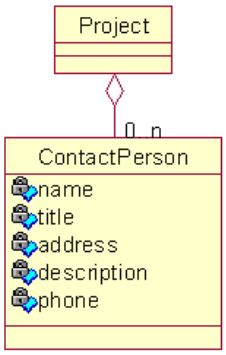
The format files of interest for this import are parsed in a certain order, directed by a list of file references.

Other types of warnings might be those telling that frequency bands are used inconsistently in the project, which will be presented as errors in the consistency check for TEMS CellPlanner.

5.6.1 Detailed Mapping of Each XML File Format

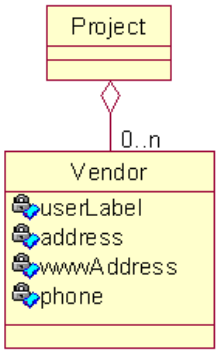
The xml format files are mapped in the following order.

Contact



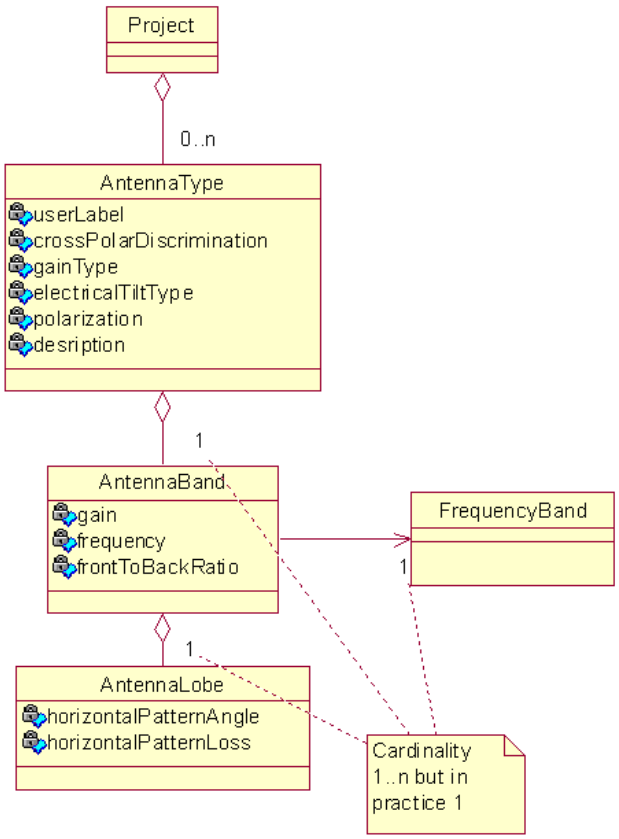
CONTACT			
Attr = ID	Project/ContactPerson	name	Required
TITLE	Project/ContactPerson	title	
FORENAME	Project/ContactPerson	name	
COMPANY	Project/ContactPerson	address	
COMMENTS	Project/ContactPerson	description	
TEL	Project/ContactPerson	phone	Array
FAX	-	-	

Supplier



SUPPLIER			Aggregate
Attr = ID	Project/Vendor	userLabel	Required
ADDRESS	Project/Vendor	address	
EMAIL	Project/Vendor	wwwAddress	
TEL	Project/Vendor	phone	
FAX	-	-	

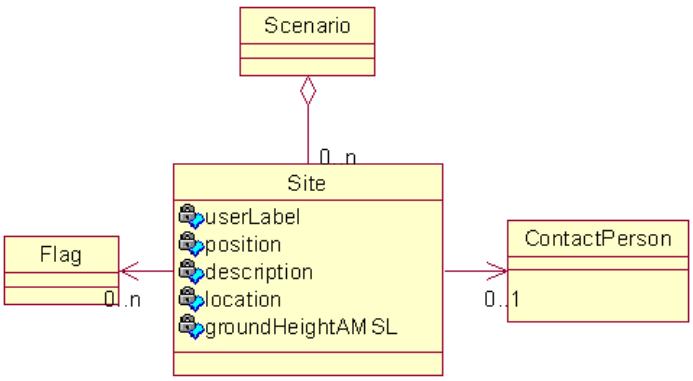
Antenna



ANTENNA	AntennaType	-	Aggregate
Attr = id	AntennaType	userLabel Rule=Required	
GAIN	AntennaType/ AntennaBand	gain	
FREQUENCY	AntennaType/ AntennaBand	frequency	
FRONT-TO-BACK	AntennaType/ AntennaBand	frontToBackRatio	
CROSS-POLAR-DISC	AntennaType	CrossPolarDiscrimination	
GAIN-TYPE	AntennaType	gainType	SourceMap=dBD,dBI TargetEnumMap=DIPOLE,ISOTROPIC

ANTENNA	AntennaType	-	Aggregate
TILT-TYPE	AntennaType	electricalTiltType	SourceMap=MECHANICAL,ELECTRICAL TargetEnumMap=NONE,FET,MET,RET
POLARISATION	AntennaType	polarization	SourceMap=VERTICAL,HORIZONTAL,CROSSPOLAR TargetEnumMap=VERTICAL,HORIZONTAL,CROSSPOLAR
H-MASK	-	-	Array
M	AntennaType/ AntennaLobe	horizontalPAtternAngle[i],horizontalPatternLoss[i]	
V-MASK	-	-	Array
M	AntennaType/ AntennaLobe	verticalPatternAngle[i], verticalPatternLoss[i]	
COST	-	-	
WEIGHT	-	-	
ICON	-	-	
SUPPLIER	Vendor	-	Reference
DESCRIPTION	AntennaSystem/Antenna/ AntennaType	description	
PHOTO-FILE	-	-	
FILE	-	-	

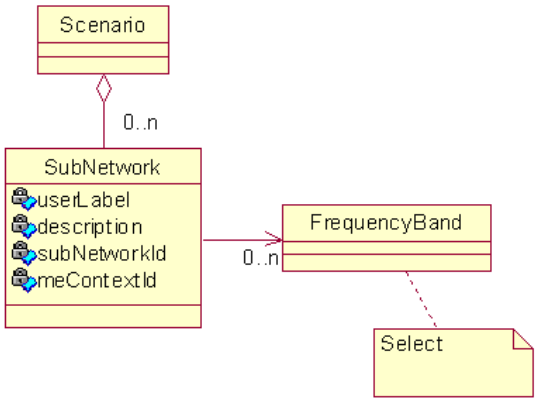
Property



AirCom tag	Target	TargetAttribute	TargetType
PROPERTY			Aggregate
Attr = ID	Site	userLabel	Required
AVAIL-HGHT	Site	groundHeightAMSL	

AirCom tag	Target	TargetAttribute	TargetType
COMMENTS	Site	description	
ADDR1	Site	location	
ADDR2	Site	location	concatinate
TOWN	Site	location	concatinate
POSTCODE	Site	location	concatinate
CONTACT	ContactPerson		Reference
LOCATION		>	
Attr =TYPE	-	-	
Attr =UNIT	-	-	
X	Site	position/latitude	
Y	Site	position/longitude	
ACT-DTM	-	-	
DTM-RO	-	-	
SEARCH	-	-	
USE2D	-	-	
CANDSTATUS	-	-	
PROPERTY-CODE	-	-	
LOCK	-	-	
STATUS	-		
FLAG	Site		
Attr = GROUP Attr = VALUE	FlagGroup	userLabel	Aggregated in pass 1. Referenced in pass 2.
	FlagGroup/Flag	userLabel	Aggregated in pass 1. Referenced in pass 2.

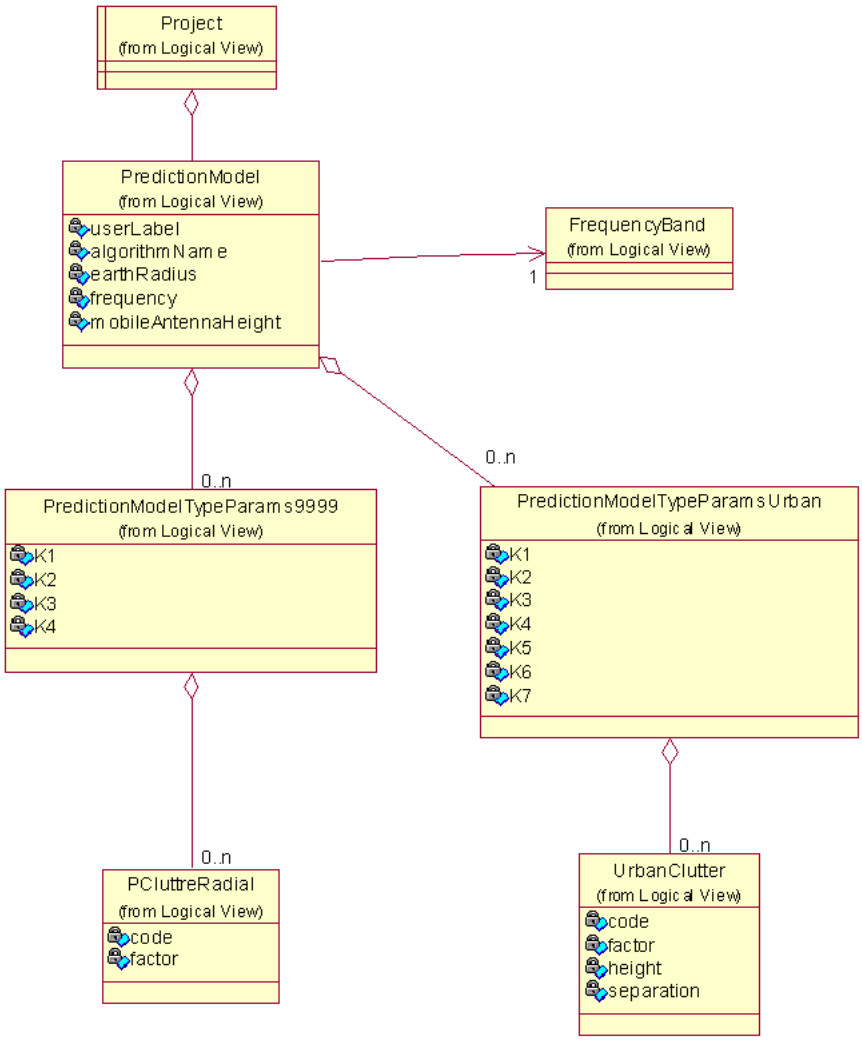
Network



NETWORK			
DEFAULT-NET	-		
NETWORK	SubNetwork		Aggregate
Attr = id	SubNetwork	userLabel	Required
ROOT-NET	-	-	
COMMENTS	SubNetwork	description	
SUBNETWORKID	SubNetwork	subNetworkId	
MECONTEXTID	SubNetwork	meContextId	not impl.
STATUS	-		
FLAG	-		
Attr = GROUP	-	-	
Attr = VALUE	-	-	
PLMN	SubNetwork		Aggregate
Attr = id	SubNetwork	userLabel	Required
PARENT-NET	-	-	
COMMENTS	SubNetwork	description	
SUBNETWORKID	SubNetwork	subNetworkId	
MECONTEXTID	SubNetwork	meContextId	not impl.
STATUS	-		
FLAG	-		
Attr = GROUP	-	-	
Attr = VALUE	-	-	

NETWORK			
MCC	SubNetwork	mcc	
MNC	SubNetwork	mnc	

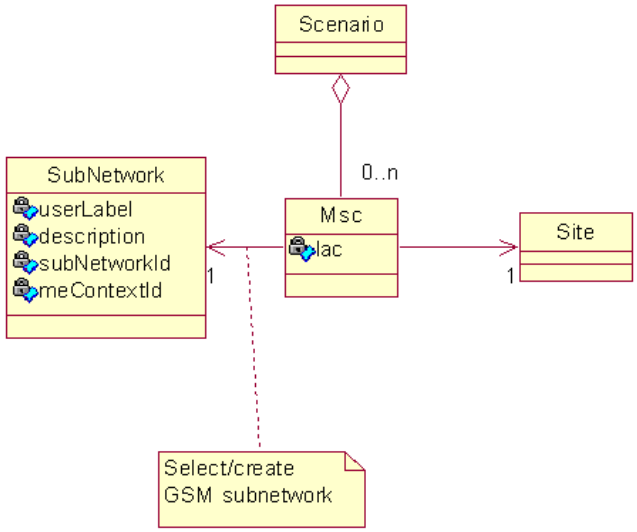
Propagation Model



MODEL			
Attr = id	Project/propagationModel	userLabel	Required
TYPE	-	-	9999/Urban/ unknown model
HEFF-ALG	-	-	-
DIFFRACTION	-	-	-

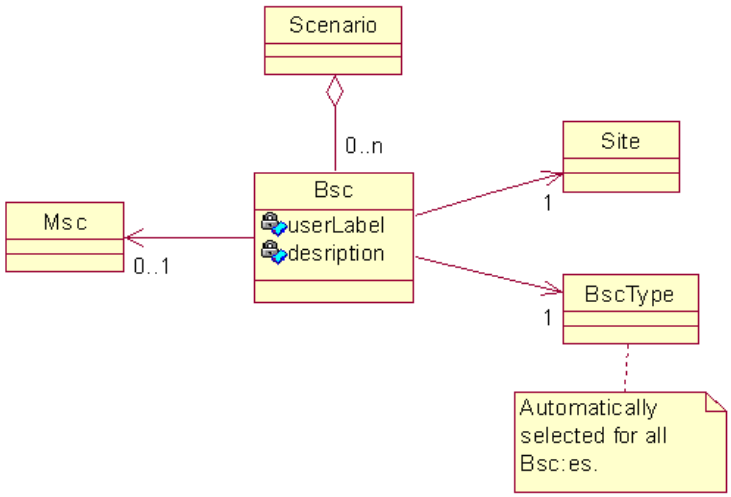
MODEL			
HEFF-MIN	-	-	-
HEFF-MAX	-	-	-
HEFF-SLOPE	-	-	-
USE-CLUTTER-HEIGHTS	-	-	-
USE-MOBILE-HEIGHTS	-	-	-
K1 - K7	PredictionModel	k[0] - k[6]	
FREQUENCY	PredictionModel	frequency	
EARTH-RADIUS	PredictionModel	EarthRadius	
MOBILE-HEIGHT	PredictionModel	mobileAntennaHeight	
STD-DEV	-	-	
CLUTTER	-	-	
Attr = id	-	-	
OFFSET CLUTTER-HEIGHT SEPARATION MOBILE-HEIGHT	PredictionModel/ PredictionModelTypeParams[9999,Urban]/ (PClutterRadial,UrbanClutter]	factor	
	PredictionModel/ PredictionModelTypeParamsUrban/ UrbanClutter	height	
	PredictionModel/ PredictionModelTypeParamsUrban/ UrbanClutter	separation	
	-	-	

MSC



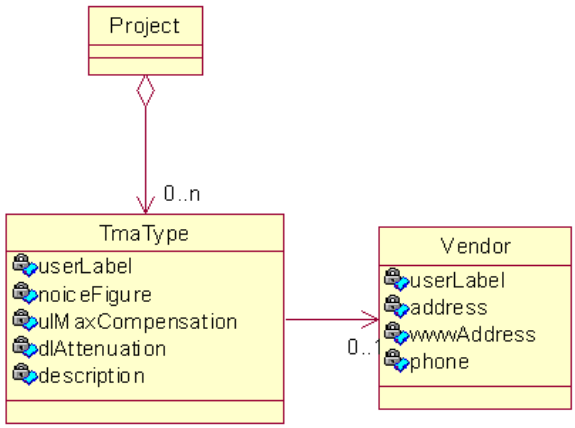
MSC			**Aggregate**
Attr = ID	Msc	userLabel	Required
TYPE			
LAC	LocationArea	lac	LAC may be missing
NAME1	-	-	
NAME2	-	-	
COMMENTS	Msc	description	NI
PROPERTY	Site		Reference Required
FREQBAND	-	-	
STATUS	-	-	
FLAG	-	-	
Attr =GROUP	-	-	
Attr =VALUE	-	-	

BSC



BSC			**Aggregate**
Attr =ID	Bsc	userLabel, if selected	Required
PARENT	Msc		Parent/Reference
NAME1	Bsc	userLabel, if selected	
NAME2	Bsc	userLabel, if selected	
COMMENTS	Bsc	description	Not impl.
PROPERTY	Site		Reference Required
FREQBAND	-	-	
STATUS	-	-	
FLAG	Bsc		
Attr =GROUP	FlagGroup	userLabel	Aggregated in pass 1. Referenced in pass 2.
Attr =VALUE	FlagGroup/ Flag	userLabel	Aggregated in pass 1. Referenced in pass 2.

Mast Head Amplifier



MAST-HEAD-AMPLIFIER			
Attr = id	Project/TmaType	userLabel	Required
NOISE	Project/TmaType	noiseFigure	
MAX-GAIN	Project/TmaType	ulMaxCompensation	
INSERTION-LOSS	Project/TmaType	dlAttenuation	
COST	-	-	
WEIGHT	-	-	
ICON	-	-	
SUPPLIER	Vendor	-	Reference
DESCRIPTION	Project/TmaType	description	
PHOTO-FILE	-	-	
FILE	-	-	

Mast

MAST			
Attr = id	Project/TowerType	userLabel	Required
HEIGHT	Project/TowerType	maxHeight	
COST	-	-	
WEIGHT	-	-	
ICON	-	-	
SUPPLIER	Project/Vendor		Reference
DESCRIPTION	Project/TowerType	description	
PHOTO-FILE	-	-	
FILE	-	-	

Feeder

FEEDER			
Attr = id	FeederCableType	userLabel	Required
LINEAR-LOSS	FeederCableTypeLoss	dlLossPerMeter[0], ulLossPerMeter[0]	
FREQUENCY	FeederCableTypeLoss	dlFrequency[0], ulFrequency[0]	
CONNECTOR-LOSS	-	-	
COST	-	-	
WEIGHT	-	-	
ICON	-	-	
SUPPLIER	Vendor	-	Reference
PHOTO-FILE	-	-	
FILE	-	-	

RNC

RNC			Aggregate
Attr = id	Rnc	userLabel if selected	Required
PLMN	-	-	Required
PROPERTY	Site		Reference Required
COMMENTS	Rnc	description	
NAME1	Rnc	userLabel if selected	
NAME2	Rnc	userLabel if selected	
NETWORK	SubNetwork	userLabel	Reference Required
STATUS	-	-	
FLAG	Rnc		
Attr = GROUP	FlagGroup	userLabel	Aggregated in pass 1. Referenced in pass 2.
Attr = VALUE	FlagGroup/Flag	userLabel	Aggregated in pass 1. Referenced in pass 2.
UMTSRNCID	Rnc	rncId	
FUNCTIONID	-	-	
MANAGEDELEMID	Rnc	meContextId	

Node B

(to be written)

Cellular-connection

CELLULAR-CONN		
END-A		
TYPE-A	Type to be connected	Rnc or NodeB
END-B		
TYPE-B	Type to be connected	NodeB or Rnc

Carrier-3G

CARRIER-3G			
Attr =id	Project/FrequencyBand/ AvailableCarrier	userLabel	Aggregate Rule=Required
INDEX	-	-	
UPLINK-CH	-	-	
DOWNLINK-CH	AvailableCarrier	downlinkNumber	
LEFT-NBR-UL-DB	-	-	
LEFT-NBR-DL-DB	-	-	
RIGHT-NBR-UL-DB	-	-	
RIGHT-NBR-DL-DB	-	-	
LEFT-NBR-CAR	-	-	
RIGHT-NBR-CAR	-	-	
LEFT_NBR_INDEX	-	-	
RIGHT_NBR_INDEX-CH	-	-	

UMTS Cell

Design around ANT-INDEX

The information in NodeB: UMTS-ANTENNA /ANT-INDEX describes the sectors/cells below Rbs. The ANT-INDEX value represents just an index, which can be used when referring from UmtsCellFormatHandler UMTS-CELL-FEEDER / ANT-INDEX. Number of UMTS-ANTENNA /ANT-INDEX:es maximized to 3, number of UMTS-CELL-FEEDER / ANT-INDEX:es maximized to 1, the rest will be disregarded and a log will be generated. Certain tricks has to be used if UMTS-ANTENNA or UMTS-CELL-FEEDER are missing.

If NodeB:s UMTS-ANTENNA is missing, the objects related to this has to be created (sector, antenna branch, utrancell etc.) in UmtsCellFormatHandler. Some data from NodeBFormatHandler will though be missing!

If UMTS:s UMTS-CELL-FEEDER is missing the UTRAN cells in UmtsCellFormatHandler appears in an the same order / Rbs as the UMTS-ANTENNA /ANT-INDEX in NodeBFormatHandler.

When more than 1 carrier is used per sector (max 4), you have to create new UTRAN cells and all below that (clone), for each cell that is referring to the same ANT-INDEX in a sector.

UMTS-CELL			
Attr = id	Sector, UtranCell	userLabel	Aggregate Required
PARENT	Parent		Required
PILOT-POWER	UtranCell	pcpich:primaryCpichPower	
CMN-CHANPOWER	UtranCell	fach:maxFach1Power	
SYNC-CHANPOWER	UtranCell	psch:schPower1	
NOISE-RISE	UtranCell	noiseRise	

UMTS-CELL			
ORTHOGONALITY	UtranCell	orthogonality	
SCRAMBLING_CODE	UtranCell	primaryScramblingCode	
MAX-ACTIVE-SET	-	-	
SOFTHO-SEARCH	-	-	
CELL-BG-NOISE	-	-	
CELL-MAX-TX-POW	UtranCell	maxTxPowerDl	
UMTSCELLID	UtranCell	cellId	
LOCALCELLID	UtranCell	localCellId	
LAC	LocationArea	lac	
RAC	RoutingArea	rac	
SAC	ServiceArea	sac	
LCR	-	-	
SECSYNCCHANPOWER	UtranCell	ssch:schPower2	
SECCMNCHANPOWER	UtranCell	fach:maxFach2Power	
SCRAMCODEGROUP	UtranCell	rach:scramblingCodeWordNo	
NUMCODEGROUPS	-	-	
NUMCODES	-	-	
CARRIER-NAME	-	-	
STATUS	-		
FLAG	-		
Attr = GROUP	-	-	
Attr = VALUE	-	-	
UMTS-CELL-FEEDER			
ANT-INDEX	-	-	
LENGTH	Sector/ AntennaBranch/ FeederCable	length	
FEEDER-TYPE	Sector/ AntennaBranch/ FeederCable/ FeederCableType		Reference
MHA-TYPE	Sector/ AntennaBranch/ Tma/TmaType	userLabel	Reference
MHA-GAIN	-	-	
TX-DIVERSITY	-	-	
RX-DIVERSITY	UtranCell	diversityGain	
CARRIER			
	FrequencyBand/ AvailableCarrier	downlinkNumber	

Carriers (GSM)

System must be setup for FrequencyBand(s). Carrier has to be between lowerEdgeChannel and upperEdgeChannel.

CARRIER			
CARRIER			
	FrequencyBand/ AvailableCarrier	downlinkNumber	

Car-Layer (GSM)

CAR-LAYER			
Attr = ID	FrequencyBand/ FrequencyLayer(FrequencyLayer/ AvailableCarrier/ downLinkNumber same as CARRIER)	userLabel	Rule=Required
oBBREV	-	-	
MAXCARS	-	-	
CARRIERS	-		
CARRIER	AvailableCarrier	downlinkNumber[i]	
IS-CTRL	FrequencyBand/FrequencyLayer SourceMap=YES/NO TargetMap=FrequencyLayerType:BCCH/TCH		
IS-MALIST	-	-	SourceMap=YES/NO TargetMap=FrequencyGroup:hop:ON/OFF
IS-LIST-ID	-	-	
USE-REUSE	-	-	
REUSE	-		
A	-	-	
B	-	-	
GROUP	-	-	
Attr = ID	Project/FrequencyGroup	userLabel Rule=Required	
CARRIER	FrequencyGroup/AvailableCarriers	downlinkNumber[i]	
PATTERN	-	-	
AMPS-CC	-	-	Do not map Carrier layers using AMPS-CC element.

Cell-Site

CELL-SITE			
Attr =id	Bts	UserLabel, if selected	Rule=Required
PARENT	Bsc	Parent	
NAME1	Bts	UserLabel, if selected	
NAME2	Bts	UserLabel, if selected	
COMMENTS	Bts	description	Not impl.
PROPERTY	Site		Reference Rule=Required
FREQBAND	-	-	-
STATUS	-	-	
FLAG	-	-	
Attr =GROUP	-	-	
Attr =VALUE	-	-	
CABIN	-	-	Reference
BTS	-	-	Reference
MAST	-	-	-
PRED-RAD	GsmCell	predictionRadius	
MSC	-	-	-

Cell-Layer

CELL-LAYER ID will be used as the SUBCELL ID in GSM-CELL. When more than 1 subcell is used in a GSM-CELL, the lowest PRIORITY in CELL-LAYER will determine which is the overlaid cell.

CELL-LAYER			
Attr = ID	Project/ HcsLayer	userLabel	Aggregate Required
PRIORITY	Project/ HcsLayer	layer	
HATCH	-	-	
QUALITY	-	-	
NETWORK	-	-	
COVERAGE-SCHEMA	-		
Attr = ID	-	-	Required
Attr = TYPE	-	-	
COVERAGE-CATEGORY	-		
Attr = ID	-	-	Required
THRESHOLD	-	-	
COLOUR	-	-	
IF-WEIGHT	-	-	

CELL-LAYER			
CHANNEL-TRX-MAP	-	-	
SUPER	-	-	

GsmCell

Rules for detecting normal/underlaid and overlaid cells.

- If only 1 subcell exists, this is automatically underlaid/normal cell.
- When no carriers allocated per CAR-LAYER, pick a random dlNumber, try to find one that belongs to the frequency band used (i.e. for propagationModel) and issue a warning message.
- If more than 1 subcell exists, i.e. 2 subcells.
- Use priority check.

Priority check means, find the respective cell layer for each subcell and check the PRIORITY (HcsLayer(userLabel == subcell name).layer, see Cell-Layer section for more information). The lowest layer value is the OL cell.

If we for a subcell, find a carlayer that is set (in car-layer-list001.xml file) as control channel, and has more than 1 carrier. A warning must be issued and the FrequencyLayerType must be set to OPEN for the carrier(s) that are not the 1 and only control channel.

What to do if none of the carriers are control channel?

- 1:st trx isBcch=TRUE if CG == isBcch TRUE.

Add antenna branches to gsmCell that are set to SLOT USE="YES".

Only 2 subcells are possible in AirCom, thus normal and overlaid cell!

GSM-CELL			Aggregate
Attr = id	GsmCell	userLabel	Rule=Required
PARENT	Bts	Parent	Rule=Required
BSIC	-		
NCC	GsmCell	ncc	
BCC	GsmCell	bcc	
GSMID	GsmCell	cellId	
MCC	SubNetwork	mcc	
MNC	SubNetwork	mnc	
TYPE	-	-	
USEP	-	-	
MODEL	PredictionModel		Reference
SECTOR	-	-	
LAC	LocationArea	lac	
DTXSTA	GsmCell	dtxFactorEnabled	

GSM-CELL			**Aggregate**
DTXFAC	-	-	
NAME	GsmCell	description	
BCCH	ChannelGroup, Trx	isBcch, isBcch	double
FCC			
SUBCELL	-		
Attr = ID	Project/GsmCell/ HcsLayer	userLabel	Reference Rule=Required
MODEL	-	-	-
OVERRIDE_MODEL	-	-	
SIG-THRESH	GsmCell	hcsLayerThreshold	
TA-THRESH	GsmCell	maxTimingAdvance	
SIG-OFFSET	GsmCell	powerOffset	
DYNAMIC	-	-	
NAME	-	-	
SUBID	-	-	
COV-MODE	-	-	
HOPTYPE	SourceMap=BaseBand/ Synt./SiteHop	TargetMap=XX=BB/SY/SY	HOPTYPE is mapped on - HOPSTATE, see TargetMap=XX.
HOPSTATE	ChannelGroup	hop	SourceMap=Off/On TargetMap=OFF/ONXX
HSN	ChannelGroup	hsn	<!-- mapped on 1:st !isBcch & IS-HOP YES -
MAIO	-	-	
MAIOFFSET	-	-	
TRAFF-CARLD	-	-	
TRX-ALLOC-RO	-	-	
AVG-DATA	-	-	
ANTENNA-CONFIG	-	-	
SLOT	AntennaBranch	antennaBranchId	
Attr = USE	?	?	
SUB-CELL-CARLD	-		
CARLAY-DATA	-		
Attr = ID	ChannelGroup	isBcch	Rule=Required
CAR-REQ	-	-	
TRX-REQ	Trx		Aggregate
			1:st trx isBcch=TRUE if CG == isBcch TRUE, Trx
MAX-CARS	-	-	
TRX-IDS	-	-	
ALLOC	-		
CARRIER	Trx	userLabel	

GSM-CELL			Aggregate
FORBID	-	-	
FIX	-	-	
IS-HOP	ChannelGroup	hop	
HOP-CARLD-LIST			
POWER	GsmCell	txPowerDl	
CCS	-	-	
GPRS-EN	GsmCell	gprsSupported	
DED-PBCCH	-	-	
TRF-PS	GsmCell	gprsTraffic	
TRF-EGPRS	GsmCell	egprsTraffic	
TRF-CS	GsmCell	csTraffic	
TRAF	-	-	
TRAFPLTHRESH	-	-	
TARGET-PL	-	-	
AVG-DATA-EDGE	-	-	
APD	-	-	
EGPRS-MIX	-	-	
ECSD-MIX	-	-	
MCS	-	-	
EDGE-EN	-	-	
ECSD-EN	-	-	
BTSID	-	-	
NON-BCCH-OFFSET	-	-	
MASTR-BTS	-	-	

ANTENNA-CONFIG

ANTENNA			
Attr =SLOT			
	AntennaBranch	antennaBranchId	Aggregate
			The AntennaBranch/ AntennaBranchType and branchName is set to Rx/Tx resp. A for first Ant.Branch, second to: Rx resp. B
FEEDLEN	FeederCable	length	
HEIGHT_OFFSET	-	-	
LOCATION	-	-	
Attr =type	-	-	
Attr =unit	-	-	
X	Antenna	relativePosition/longitude	

ANTENNA			
Y	Antenna	relativePosition/latitude	
FEEDER	FeederCable	-	Reference
TYPE	AntennaType	-	Reference
AZMTH	Antenna	beamDirection	
TILT	Antenna	mechanicalAntennaTilt	
HGHT	Antenna	heightAGL	
CORR-FACT	-	-	
EQUIP	-	-	
CORR-FACT	-	-	
STATUS	-	-	Flags of no interest.

Neighbor

NEIGHBOUR			
GSM-CELL	GsmCell	-	Reference
Attr =ID	GsmCell	userLabel	Rule=Required
NEIGHBOUR	-	-	
Attr = ID	GsmCell/ UtranCell	userLabel	Rule=Required SourceMap=GSM,UMTS TargetMap=GsmRelation/GsmCell,UtranRelation/ UtranCell
HANDOVER-MARGIN	-	-	
TECHNOLOGY	-	-	SourceMap=GSM,UMTS TargetMap=GsmRelation,UtranRelation
HANDOVER-TYPE	-	-	
UMTS-CELL	UtranCell	-	Reference
Attr = ID	UtranCell	userLabel	Rule=Required
NEIGHBOUR	-	-	
Attr = ID	GsmCell/ UtranCell	userLabel	Rule=Required SourceMap=GSM,UMTS TargetMap=GsmRelation/GsmCell,UtranRelation/ UtranCell
HANDOVER-MARGIN	-	-	
TECHNOLOGY	-	-	SourceMap=GSM,UMTS TargetMap=GsmRelation,UtranRelation

5.7 EET/Planet System File

When you select a system file from EET/Planet to import, TEMS CellPlanner determines the format from the content of the file and calls the appropriate import routine. The application assumes that an EET system file is ASCII text with space-delimited columns. To determine that a file is in EET format, the application looks for three consecutive lines of text near the top of the file. The first of the lines starts with the string "SITE_FORMAT," the second starts with "SECTOR_FORMAT," and the third starts with "CELL_INFO_FORMAT." The strings are case sensitive. The following excerpt illustrates the format of the file:

```
V2.6 Site Database written on Fri Nov 14 14:07:17 1997
SITE_FORMAT EiRP   : Do not delete this line
SECTOR_FORMAT    : Do not delete this line
CELL_INFO_FORMAT : Do not delete this line
SITE 1 130.955002 33.937778 0 0 0 0 0 0.00 0 2 Mekari
SECTOR 60 53.00 0.0 22S60_1 28.20 Kyushu_S1
CELLINFO Default Non-Balanced 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 35
SECTOR 210 53.00 0.0 22S60_1 28.20 Kyushu_S1
CELLINFO Default Non-Balanced 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 35
SITE 2 130.935562 33.831390 0 0 0 0 0 0.00 0 3 Shimosone
SECTOR 30 53.00 0.0 22S60_1 38.50 Kyushu_S1
CELLINFO Default Non-Balanced 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 35
SECTOR 150 53.00 2.0 22S60_1 38.50 Kyushu_S1
CELLINFO Default Non-Balanced 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 35
SECTOR 290 53.00 0.0 22S60_1 38.50 Kyushu_S1
CELLINFO Default Non-Balanced 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 35
```

As an intermediate step of the conversion, TEMS CellPlanner generates a TEMS CellPlanner system file stored in the `/tmp` directory. This new file is named after the EET system file (without the path) with the suffix "`_wcdma`". The application automatically imports the new file without requiring user intervention. You can view the new TEMS CellPlanner file for information or modify its contents and then import it as a standard system file.

5.7.1 Mapping EET and TEMS CellPlanner Parameters

The following table outlines the mapping of EET parameters to the TEMS CellPlanner parameters. The table also shows the default values of the parameters where there is no equivalent information from the EET file.

TCP Parameter	EET Parameter	Default Value
Technology	N/A	WCDMA
Frequency	N/A	850 MHz

TCP Parameter	EET Parameter	Default Value
ON/OFF Signal	N/A	ON
Site Code	Site Id (truncated)	
Site Name	Site Name + Site Name2	
Sector Code	N/A	Derived from the EET Alignment parameter: • Up to 120 = "Alpha" • From 120 to 240 = "Beta" • From 240+ = "Gamma"
Latitude	Northing/Latitude (converted)*	
Longitude	Easting/Longitude (converted)*	
Ground Elevation	Ground Height	
Antenna Code	Antenna Name**	
Height	Antenna Height	
Theta	Alignment	
Tilt	Tilt	
Tilt Type	N/A	If Tilt < 0.1, then "NONE". Otherwise, "MECH".
Max PA Power	N/A	20 watts
Max Radius	N/A	10 km
RF Model Code	Model Name**	
RF Model Class	N/A	"No Name"
RF Model Coefficients	N/A	0
Extra RF Losses	Equipment Loss	
Noise Figure	N/A	0
Xmt Losses	DownLink Feeder Loss + DownLink Misc. Loss	
Rcv Losses	UpLink Feeder Loss + UpLink Misc. Loss	
Max Power	N/A	4 watts
Initial Pilot Channel Digital Gain	N/A	108
Paging Channel Digital Gain	N/A	65
Sync Channel Digital Gain	N/A	34
Traffic Channel Digital Gain	N/A	55
Minimum Pilot Channel Gain	N/A	60

TCP Parameter	EET Parameter	Default Value
Maximum Pilot Channel Gain	N/A	127
Minimum Traffic Channel Gain	N/A	45
Maximum Traffic Channel Gain	N/A	96
Handover Threshold	N/A	0 dB
Pilot Flag	N/A	0
Target Minimum E_c/I_o	N/A	0
Reverse Link Required E_b/N_t	N/A	7 dB
Scrambling Code	N/A	0
Search Window Size	N/A	0
Cell Type Number	N/A	If Site Type Flag parameter is Repeater Site, then "PBU". Otherwise, "STD".
Channel	N/A	450

5.8 Antenna File Format

The antenna import file format has a number of generic traits that apply no matter where the file is being imported from. Antennas can be imported in two different formats into TEMS CellPlanner:

- Generic file format
- TEMS CellPlanner / EET File Format

The formats of the antenna file formats are described in the following sections.

5.8.1 Generic File Format

This section describes the generic traits of an antenna import file format.

Each of the first 20 lines of the import file has a comment describing the information, the unit or type of the value, and whether it is required or optional. The value may be a number, a floating point or an enumeration type, or a character string, in which case no unit type is provided. Below is an example of lines with three types of values.

DAPA	## manufacturer (REQ)
59000	## model (REQ)
18.54	## maximum antenna gain (dBi) (REQ)
	…
2	## polarization (0:unknown, 1:horz, 2:vert) (OPT)

To omit a value for an optional item, leave the comment line or a blank line as a placeholder so that there are always 20 lines of file header information.

Horizontal Radiation Pattern

The next set of lines describes the horizontal radiation pattern for the antenna, as in the following excerpt:

```
## Horizontal Radiation Pattern ##
   0.00    -0.01
   1.00    -0.02
   2.00    -0.03
   3.00    -0.05
```

The import utility searches for the pound symbol (#) in the *first* column to indicate the beginning of the horizontal pattern.

0 degrees represents the direction in front of the antenna.

The number of data points given for each pattern is up to you and do not have to be evenly spaced. The angles for the horizontal pattern range from 0 to 360 degrees. *The dB values specified for each angle are relative to the maximum antenna gain*. The maximum antenna gain is specified in line 3 of the header file.

Vertical Radiation Pattern

The next set of lines describes the vertical radiation pattern for the antenna, as in the following excerpt:

```
## Vertical Radiation Pattern ##
-179.50   -25.57
-178.50   -25.56
-177.50   -25.60
```

The import utility searches for the pound symbol (#) in the *first* column to indicate the beginning of the vertical pattern.

For the vertical pattern, -180 degrees is behind the antenna, -90 degrees is toward the ground, +90 is directly above the antenna, and +180 is in front of the antenna.

You can define the number of data points for each pattern and they do not have to be evenly spaced. The angles for the vertical pattern range from -180 to +180.

Example Header Lines of Antenna Import File

The following table shows twenty header lines of a sample antenna import file.

Header Line	Description
DAPA	## manufacturer (REQ)
59000	## model (REQ)
18.54	## maximum antenna gain (dBi) (REQ)
92.00	## horizontal beamwidth (deg) (REQ)
5.50	## vertical beamwidth (deg) (REQ)
25.00	## front-to-back ratio (dB) (OPT)
1710.00	## minimum operating frequency (MHz) (REQ)
1990.00	## maximum operating frequency (MHz) (REQ)
500.00	## maximum input power (W) (OPT)
50.00	## input impedance (Ohms) (OPT)
1.50	## voltage standing wave ratio (OPT)
6.60	## weight (kg) (OPT)
0.28	## wind area (sq. m.) (OPT)
200.00	## max wind speed (kph) (OPT)
2	## polarization (0:unknown, 1:horz, 2:vert) (OPT)
2	## downtilt (0:unknown, 1:none, 2:elec, 3:mech) (OPT)
	## lightning protection (OPT)

Header Line	Description
N OR 7/16 DIN	## connector type (OPT)
1.78	## height (cm) (OPT)
0.00	## width (cm) (OPT)
0.00	## depth (cm) (OPT)
ABS	## random type (OPT)

If you want to omit a value for an optional item, leave the comment line or a blank line as a placeholder so that there are always 20 lines of file header information.

5.8.2 TEMS/CellPlanner/EET File Format

Antenna Diagrams

TEMS CellPlanner must first import antenna diagrams before they can be used within the application. A header section begins the antenna file that must contain at a minimum the antenna name field. The complete list of fields is shown in the following table:

Field	Description
NAME	Antenna name
MAKE	Make/manufacturer
FREQUENCY	Frequency (MHz)
H_WIDTH	Horizontal beamwidth (degrees)
V_WIDTH	Vertical beamwidth (degrees)
FRONT_TO_BACK	Front to back ratio (dB)
GAIN	Antenna gain (dBi)
TILT	Tilt type (ELECTRICAL/MECHANICAL /CROSS POLAR)
COMMENTS	Additional comments

After the header follow two sections pre-fixed with the name of the particular pattern that will be described, such as HORIZONTAL or VERTICAL, and the number of points. The number of points need not equal 360.

Each successive row then contains the variables separated by a space as shown in the following table:

Field	Description
Angle	Angle of data point from the main forward beam direction - anticlockwise (degrees)
Loss	Relative to the maximum (dB)

An example antenna file is shown below:

NAME	085_2_18
MAKE	Antennas'R'Us
FREQUENCY	900
H_WIDTH	85
V_WIDTH	10
FRONT_TO_BACK	0
GAIN	19 dBi
TILT	MECHANICAL
COMMENTS	Standard 85-degree antenna
HORIZONTAL	360
0.0	0.0
1.0	0.0
2.0	0.0
.....	.....
353.0	0.1
354.0	0.1
358.0	0.1
359.0	0.0
VERTICAL	360
0.0	0.4
1.0	0.0
3.0	1.1
.....	.....
355.0	25.4
356.0	16.5
359.0	2.3

The final row is terminated by a carriage return. Additional data present after the pattern section is ignored.

Following the header are two sections prefixed with the name of the pattern to be described, HORIZONTAL or VERTICAL, and the number of points. The number of points need not equal 360. Each successive row then contains the variables separated by a space, as shown in the following table:

Field	**Description**
Angle	Angle of data point from the main forward beam direction – anticlockwise (degrees)
Loss	Relative to the maximum (dB)

Antenna Parameter Mapping

The following table shows the mapping of TCP/EET/Planet antenna parameters to TEMS CellPlanner windows.

TCP/EET/Planet Parameter	TEMS CellPlanner Window and Field
NAME	Antenna Type::User label
MAKE	Antenna Type::Model
FREQUENCY	Antenna Band::Frequency [MHz]
H_WIDTH	Antenna Band::Half Power Beam Width Horizontal [deg]
V_WIDTH	Antenna Band::Half Power Beam Width Vertical [deg]
FRONT_TO_BACK	Antenna Band::Front to Back Ratio
GAIN	Antenna Band::Max Gain Antenna Type::Gain Type = dBi (default)
TILT =	
ELECTRICAL	Antenna Type::Electrical tilt type = MET
MECHANICAL	Antenna Type::Electrical tilt type = NONE
CROSSPOLAR	Antenna Type::Electrical tilt type = NONE
COMMENTS	Antenna Type::Description
VERTICAL	Angle Antenna Band::Vertical Pattern Angle [deg]
<VERTICAL> Loss	Antenna Band::Vertical Pattern Loss [dB]
HORIZONTAL	Angle Antenna Band::Horizontal Pattern Angle [deg]
<HORIZONTAL> Loss	Antenna Band::Horizontal Pattern Loss [dB]
	Antenna Band::Frequency Band
	Antenna Type::Project specific=TRUE
	Antenna Type::Item Number
	Antenna Type::Polarization
	Antenna Type::Cross polar discrimination
	Antenna Band::Frequency range
	Antenna Band::Side Lobe Suppression
	Antenna Band::Max Electrical Down tilt

Example Antenna File

An example antenna file is shown below.:

NAME	085_2_18
MAKE	Antennas 'R' Us
FREQUENCY	900
H_WIDTH	85
V_WIDTH	10
FRONT_TO_BACK	0
GAIN	18 dBi

NAME	085_2_18
TILT	MECHANICAL
COMMENTS	Standard 85-degree antenna
HORIZONTAL	360
0.0	0.0
1.0	0.0
2.0	0.0
....	
353.0	0.1
354.0	0.1
358.0	0.1
359.0	0.0
VERTICAL	360
0.0	0.4
1.0	0.0
3.0	1.1
...	
355.0	25.4
356.0	16.5
359.0	2.3

The final row is terminated by a carriage return. Additional data present after the pattern section is ignored.

5.9 Site Database Files

TEMS CellPlanner can import and export the EET/R2C/Planet 2.7 simple text site database file format.

5.9.1 Site Database File Header Records

Each site database file has one of each of the records as shown in the following table:

Field	Data Type	Description
Version Identifier	CHAR ()	Identifies the version of EET that was used to store the database. For version 2.7 this is "V2.7"
Optional Message	CHAR()	The time and date that the database was last stored
Site format	CHAR()	ERP or EiRP

Sector Data Record Format

This type of record is not used, but it must exist in the file.

Cell Data Record Format

This type of record is not used, but it must exist in the file.

5.9.2 Site Database File Data Records

Site Data Record

The site database file has one site data record per site. The following table describes the fields in a site data record:

Field	Data Type	Description
Keyword	CHAR (4)	"SITE" identifies the record
Site ID	CHAR (11)	Unique identifier for the site
Easting/ Longitude	FLOAT	The x_coordinate of the site (meters or decimal degrees)
Northing/ Latitude	FLOAT	The y-coordinate of the site (meters or decimal degrees)
Site Status Flags	INT(5)	Numeric representation of the site status flags
Ground Height	FLOAT	The height of the site above mean sea level (meters)
Hexagon Flag	INT	Numeric representation of the hexagon radius and type.

Field	Data Type	Description
Site Type Flag	INT	A decimal number of up to three digits that has the site type and number of sectors encoded into it, as follows: • --N=Number of Sectors (N in range 1 - 6) • -0- = Macrocell • -3- = Microcell • 1--= Repeater Site
Site Name	CHAR (23)	Optional string that can contain anything (including spaces)
Site Name 2	CHAR (23)	Optional string that can contain anything (including spaces)
Narrative	CHAR (80)	Optional string that can contain anything (including spaces)

5.9.3 Sector Data Records

A site database file has one sector data record per sector of every site. The following table describes the fields of a sector data record:

Field	Data Type	Description
Keyword	CHAR(6)	"SECTOR" identifies this record
Alignment	FLOAT	Angle from North of sector (degrees)
Power	FLOAT	ERP or EiRP of sector (dBm) depending on the value of the Site Format field in the Header Record. All power values must be consistent (all ERP or all EiRP)
Tilt	FLOAT	Downtilt of sector (degrees)
Antenna Name	CHAR(99)	Name of antenna (no spaces allowed)
Antenna Height	FLOAT	Height of antenna above ground (meters)
Model Name	CHAR (31)	Name of propagation model (no spaces allowed)

Cell Data Record

A site database file has one cell data record per sector of every site. The following table describes the fields of a cell data record:

Field	Data Type	Description
Keyword	CHAR(8)	"CELLINFO" identifies the start of the cell information details
Equipment Type	CHAR(21)	The equipment type the cell uses
Balanced mobile	CHAR (21)	Mobile / CE type the cell is presently balanced for. If the cell is not balanced then defaults to non-balanced

Field	Data Type	Description
Equipment Loss	FLOAT	Sum of all the downlink losses / +gains from the presently selected cell equipment
Output Power	FLOAT	Do not change from zero
Uplink Feeder Loss	FLOAT	The feeder loss applicable to the uplink side
Downlink Feeder Loss	FLOAT	The feeder loss applicable to the downlink side
Diversity Gain	FLOAT	The diversity gain from the cell, if applicable
Uplink Misc Loss	FLOAT	The miscellaneous losses on the uplink side.
Downlink Misc Loss Mobile ERP	FLOAT	The peak power of the mobile/CE type for which the cell is balanced.
GSM Range	FLOAT	A definable range applicable only to GSM systems. Interference in this cell from two other servers is not considered, because the cell cannot cover beyond this range. However, the cell can interfere in other cells independent of the range.

5.10 Fixed Subscriber Files

TEMS CellPlanner can import and export fixed subscribers for LTE and WiMAX.

5.10.1 File Format: Fixed Subscribers File

An import or export file with LTE fixed subscribers is a tab delimited ASCII text file with a generic format as described in Generic Import File Format on page 5-2.

Each row contains the following attributes:

- Name of the fixed subscriber (string)
- Name of the site (string)
- Site position expressed as Longitude/Latitude or East/North (floats)
- Antenna height AGL (float)
- Ground height overridden, one of true of false (boolean)
- Overridden ground height AGL (float)
- Fixed subscriber profile name (string)

5.10.2 Import Rules of Fixed Subscribers File

If any attribute is missing in the import file, the project is updated according to the following rules:

1. When the site name in the fixed subscribers text file does not match any existing site name, a new site is created from the information in the import file.
2. If 1 above is fulfilled, but no coordinates are present for the site in the import file, the fixed subscriber is not imported. A message notifies which fixed subscriber could not be imported and the reason for not importing. The import continues with the next fixed subscriber in the import file.
3. When the site name in the fixed subscriber text file matches one of the existing sites, but the site does not have any fixed subscriber, the fixed subscriber from the import file is added to the existing site.

   Note: *Coordinates in the import file are ignored, that is, the site location remains as defined in the project.*

4. If the site name in the fixed subscriber text file matches one of the existing sites, and the existing site already has a fixed subscriber, the existing fixed subscriber is updated from the import file.

   Note: *Coordinates in the import file are ignored, that is, the site location remains as defined in the project.*

5. If 1, 3 or 4 above is fulfilled but the subscriber profile of the site to import does not match the site's LTE fixed subscriber profile in the project, the fixed

subscriber is not imported. A message notifies you about which fixed subscriber could not be imported and the reason for not importing. The import continues with the next fixed subscriber in the import file.

5.10.3 Example: Fixed Subscribers File

The example below shows a fixed subscriber file, originally in text format but here opened in MS Excel™:

LTE fixed subscribers.xls

	A	B	C	D	E	F	G
1	LTE Fixed Subscribers						
2	Version	1					
3	TCP version	9.0.0.231 (Info model: 82)					
4	Technology	LTE					
5	Date	Sep 8, 2009 4:33:47 PM					
6	Comment						
7	Coordinates	RT90 Sweden/LocalLongLatDecimal					
8							
9	Subscriber-00013 Fixed sub	Site-00013 Fixed sub	18.007199/59.357689	5.0	FALSE	0.0	LTE fixed subscriber profile
10	Subscriber-00014 Fixed sub	Site-00014 Fixed sub	18.031841/59.381542	5.0	FALSE	0.0	LTE fixed subscriber profile
11	Subscriber-00015 Fixed sub GBR	Site-00015 Fixed sub GBR	17.966997/59.384614	5.0	FALSE	0.0	LTE fixed subscriber profile GBR
12	Subscriber-00016 Fixed sub GBR	Site-00016 Fixed sub GBR	18.019417/59.404978	5.0	FALSE	0.0	LTE fixed subscriber profile GBR

You can conveniently work with this file as a spreadsheet. You though have to save the file in text format before importing it into TEMS CellPlanner.

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